PUBLIC WORKS

Devoted to the interests of the engineers and technical officials of the cities, counties and states

JUNE, 1938

A. PRESCOTT FOLWELL, Editor — VOL. 69, NO. 6 — W. A. HARDENBERGH, Asso. Editor

Contents

TIMEWASTERS

With the well-known summer lassitude coming on, it's getting pretty hard to find much time to waste. It's like the man who had so many irons in the fire he had to go home and do some ironing. Now, about the cows and the grass, Gus Sauer from down in the cow state of Texas says that there they just lay it out on the ground, cut the grass, weigh it—and there you are! He says, as a result of his work, that he wouldn't give a cent more than $2.17½ for what those two cows left. And that's about right, according to its author, Mr. Blunk.

The other problem in the May issue which involved a choice between walking across country, or along the road, was a good one. The time required was 1 hour and 6 minutes; if the walker picked a spot 2.82 miles from A as his mark on the road, and walked thence down the highway to B he made it in this minimum time.

A Different Ladder Problem:

Two ladders of unequal length are placed across an alley, intersecting 2 ft. above the pavement. Designating the ladders as *ab* and *cd*, the intersection as *e* and the projection of the intersection as *f*, and assuming that *ab*, *bc*, *cd* and *ad* are all whole numbers, how wide is the alley? Contributed by *John Bevan.*

It's Old, But It's Awfully Tough:

A number ends with the digit 2. Move this digit from the right end of the number to the left of it; the number is now just twice as great as it was before. What is the number?

Another Digitary Problem:

From a 3-digit number, subtract one-fourth of its value; the result is a 3-digit number containing the same three digits as you started with; from this second number, subtract again one-fourth of its value. The result is a number containing the same three digits that you started with. What is the number?

W. A. H.

SUBSCRIPTION RATES: United States and Possessions, Canada, Mexico and Cuba, $3.00. All other countries, $4.00. Single Copies, 35 cents each.

FOUNDED IN 1896

Published monthly by the PUBLIC WORKS JOURNAL CORPORATION, 310 E. 45th St., New York, N. Y. J. T. MORRIS, *President;* W. A. HARDENBERGH, *Vice-Pres.;* CROXTON MORRIS, *Treasurer. Advertising Manager,* ARTHUR K. AKERS, 310 East 45th St., N. Y. *Advertising representatives,* FRED R. JONES, 228 No. La Salle St., Chicago, Ill.; ALONZO HAWLEY, 1635 E. 25th St., Cleveland, Ohio.

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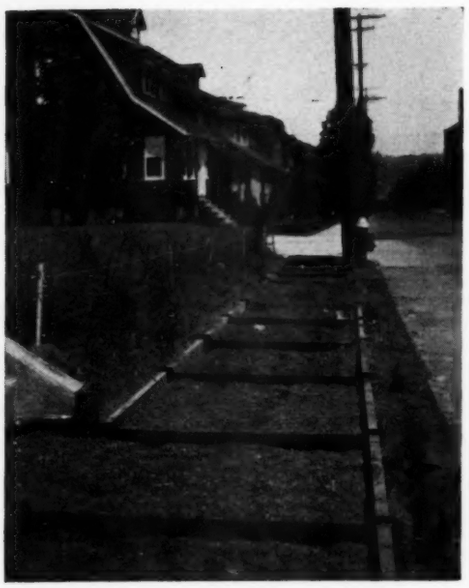
PUBLIC WORKS
City, County and State Engineering and Construction

JUNE, 1938
VOL. 69. NO. 6

Sidewalks for 45¢ a Front Foot

By GEORGE F. MALLEY
Commissioner of Public Works, Ridgefield Park, N. J.



Cinder base and forms for sidewalks

IN August, 1937, the Village of Ridgefield Park, New Jersey, placed in operation a WPA project to replace all the present flagstone sidewalks throughout the village with new concrete walks of standard design. More than half of the 42 miles of sidewalks in the village were of the well known blue flagstone, 4 feet wide, and in rather deplorable condition from old age and lack of attention, and a steadily increasing number of complaints made it imperative that some economical solution, municipal-wide in scope, be found at once.

With the enthusiastic cooperation of the local Works Progress Administration office, there was developed a village-wide project which would remove the present walks, lay a new 4 feet wide concrete walk, 4 inches thick on a 4 inch bed of tamped cinders, together with a driveway apron, if required, along the front of any property whose owner so requested.

Following the passage of the usual ordinance, notifying the property owners that sidewalks must be fixed within 30 days, and, if not fixed within this time limit, that the Department of Public Works would proceed to fix and charge, a form was mailed to each and every property owner in the municipality which, when signed by the property owner, gave the Department of Public Works the authority to replace the sidewalk, under the W. P. A. Project.

The agreement between the Department of Public Works and the property owner stipulated that the cost of the sponsor's share would be charged against the property on a basis of the lineal footage of walk constructed at $0.45 per lineal foot of frontage. The driveway apron, although 6 inches thick and of sufficient width to reach from the edge of the sidewalk to the curb, entailed no extra charge and was to be billed on the same per foot basis. It was further agreed that no work would be done inside the sidewalk line.

The project was placed in operation with a small crew in the south section of the municipality. When first started, not many property owners had authorized the D. P. W. to proceed. The locations were spotty, and, in many blocks, there was only one signee. But hardly was the first day's actual pour set before skeptical neighbors began to inquire of the foremen and inspectors if they could still file their authorization, and, in less than a week after the first sidewalk section was complete, it was necessary to assign a contact man to the area in which the construction forces were working to care for the increase in authorization.

By the end of August, a second gang was started in the north end of the town, with the same satisfying experience. By the end of September, 800 of the 1500 properties with existing flagstone walks had been signed up and, at this date, more than 1200 have authorized the D. P. W. to install new walks.

No doubt your readers will wonder how it is possible to furnish this service for $0.45 per lineal foot. This may be explained through the use of ready-mixed concrete, purchased at $6.70 per cubic yard, cinders free for the hauling, and the W. P. A. furnishing all labor costs. Another item, which prompted us to keep

Type of sidewalk which was replaced with concrete

the cost to the property owner as low as possible, was the inclusion in the agreement between the property owner and the D. P. W. that all flagstone should become the property of the Department of Public Works. Through this measure, we have accumulated a huge supply of flagging and are now using that flagging throughout the municipal park system for walks, platforms, etc. Additional revenue has accrued to the municipality through the sale of much of this reclaimed flagging to home-owners for landscaping, etc.

The official project has since been expanded by the W. P. A. and it is hoped that, by the end of the season, a large portion of the area to be residewalked will have been completed.

How Austin Finances Garbage Collection

By J. H. Weiland, City Clerk, Austin

AUSTIN, MINN., furnishes garbage collection service to its citizens through private scavengers, who perform this service for the city under contract. Under this contract the scavengers furnish all their own help, equipment, and dumping grounds, and their remuneration is fixed at seventy-five per cent of the gross receipts. The city receives the other twenty-five per cent.

This garbage collection service is not compulsory. The city provides a separate, city-maintained dump for those who wish to dispose of their own garbage. Anyone who desires pickup service first signs an application card, a duplicate of which is kept in the city clerk's office, and thereafter receives the service twice a week, including, from September to May, the removal of ashes as well as garbage and refuse, if separate containers are provided by the householder.

The charge for this service, as fixed by ordinance, is as follows:

75c per month for each garbage can or receptacle used by a family or household.

$1.50 per month for each garbage can or receptacle used by hotel, restaurant or cafe.

Discount: 25c per month if bill is paid by the 10th of the month following that during which service was rendered.

The net bill for twice a week service to the householder therefore is fifty cents a month. Bills are sent out by the city clerk at the end of each month on an ordinary penny post card. This card is so printed that a portion of the card may be torn off and used as a cash receipt slip by the clerk, the customer retaining the other portion as his receipt. For the convenience of those who fail to bring their card a duplicate card of another color is kept, on which to record the charge and payment.

A ledger card is maintained for every customer upon which is noted the customer's name, the address served, date service started, date service was discontinued and the gross charge, discount and amount paid by months. The cash receipt slips retained by the clerk at the time of payment are posted to these cards.

Service is discontinued when any customer so desires and the date noted on both the original and the duplicate of the application card.

Both the city and the customer served feel that this arrangement provides satisfactory service at a very reasonable cost and this feeling is expressed by the growth in the number of customers, which is now in excess of 1,100. The city's share of the revenue more than pays all overhead costs.—*Minnesota Municipalities.*

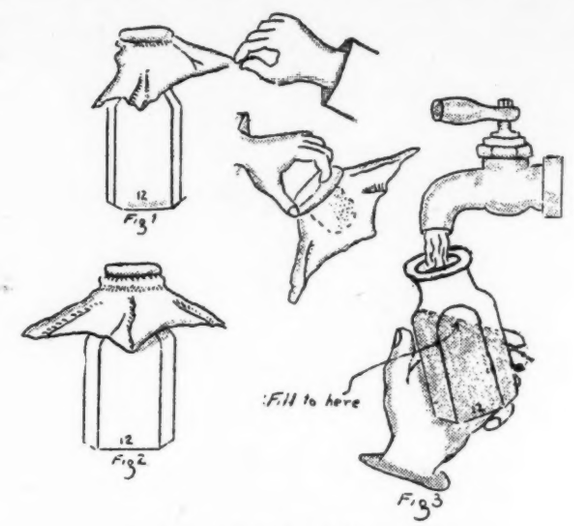
Collecting Water Samples for Bacteriological Analysis

The State Board of Health of South Dakota makes the following recommendations of procedure in the collection of samples of which bacteriological analyses are to be made.

Samples should be collected from a tap or faucet if possible, taking one sample of the water as it leaves the well, others from the distribution system.

First, turn the faucet on and let the water run until you feel sure that all water has drained out of the service pipe. Then remove a bottle from the container and pull out the four corners of the foil covering as shown in Figure 1. When this is completed, the foil will form an umbrella over the bottle, similar to Figure 2. Do not remove the foil covering from the stopper.

You are now ready to collect the sample. Hold the bottle in one hand and with the other, remove the stopper and foil covering together, as shown in Figure 3. Do not lay the stopper and foil covering down, but hold it in a downward position, thus the foil will shield the stopper from falling dust particles. Hold the bottle under the faucet and fill to approximately the line shown in Figure 3. Allow only a small but steady stream to flow from the faucet when filling. Do not splash on the lip of the bottle any more than necessary. Immediately remove the bottle from underneath the faucet and replace the stopper. Press the foil around the neck of the bottle and return the bottle to the container.



Procedure in taking water samples

In removing the stopper and replacing it in the bottle, be sure to not touch either the stopper or the lip of the bottle with the foil. There may be some dust-carried contamination on the foil which could be carried to the bottle in this way, and washed into the bottle when collecting the sample.

Fill out the enclosed data sheet completely. The bottle number will be etched into the glass on one side of the bottle, as shown in the illustrations.

As an added precaution and to insure the destruction of any bacteria or germs which may be clinging to the faucet, a blow torch can be used to heat the faucet. The flame of the torch should not be merely passed over the faucet, but should be held on the faucet for some little time, until the faucet shows indications of being hot. The flame of the torch should be directed against the inside edge of the faucet. ALL SCREW TYPE FAUCETS SHOULD BE FLAMED.

Six downflow magnetite filters at Denver, Colo., for straining plain settled and chemically precipitated effluent

Separation of Solids From Liquids in Sewage Treatment

By S. I. ZACK

Sanitary Engineer, Filtration Equipment Corporation

ONE of the principal problems of sewage treatment resolves itself into the segregation of about 0.02 pound of solids from each 100 pounds of liquid. By sedimentation and chemical precipitation 50 to 80% of the solids are removed, increased to 85 to 90% by secondary treatment. The solids so removed as sludge are still combined with 10 to 50 times their weight of water. By digestion, about one-third of the solids can be destroyed, the digested sludge still containing 85 to 90% water.

One of the outstanding features of recent progress in sewage treatment has been the adaptation of mechanical filtration to speed up the separation of fine solids from the liquid sewage, and rapid dehydration of wet sludges to facilitate final disposal of them. The former permits reducing the size of settling tank or increasing the total clarification, or both. Rapid sludge dehydration is effected in many plants by means of rotary vacuum filters. Much experimental work has been done on the use of centrifuges for this purpose, and a few are in service operation for dewatering screenings.

Filter Effluent Strainers

The Laughlin automatic magnetite filter is thus far the only mechanically cleaned thin bed strainer that has had full-scale operating experience. This consists of a 3-inch bed of magnetite, which is cleaned automatically by a travelling solenoid. They are made of both the upflow type, installed on the periphery of a circular settling tank, and the downflow, installed on rectangular separate structures.

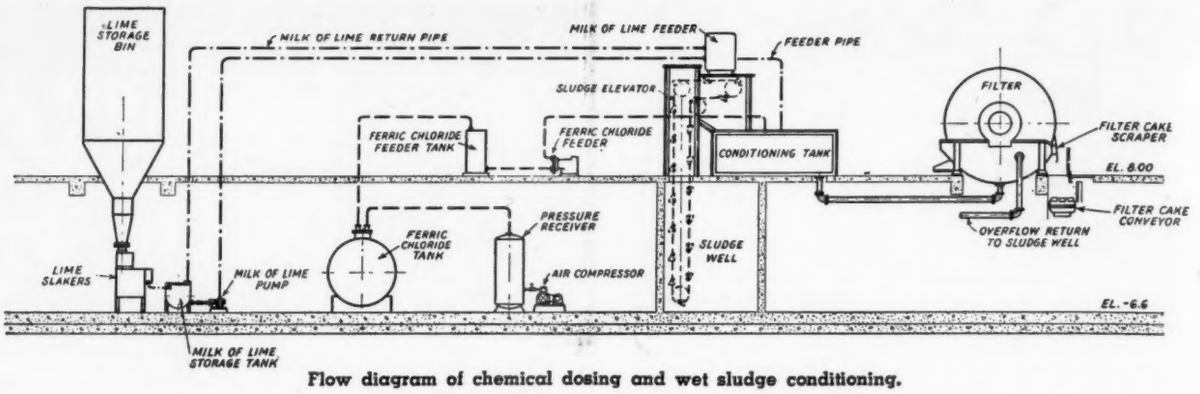
Those built to date are used for 1—All-year straining of chemically precipitated effluent. (Dearborn, Mich.) 2—All-year straining of plain settled effluent (Goshen, Ind., Chillicothe, O.). 3—Seasonal chemical effluent (Perth Amboy, N. J., Lakeland, N. J., Elmira, N. Y., Denver, Colo.; also Minneapolis and Barberton, O., just placed in operation). 4—For trickling filter effluent (Columbus Grove, O., Atlanta, Ga.; also Cleveland, O., just completed). 5—For activated sludge. (Greece, N. Y. under construction). 6—Two full-scale downflow filters experimenting with chemically precipitated and plain settled Imhoff effluent at the West Side Plant, Sanitary District of Chicago.

The magnetite is 0.85 m m size in all of these except Denver and Chicago, where 0.60 m m size is used. All are upflow on the periphery of circular settling basins except those at Denver, Chicago, Barberton, Minneapolis and Cleveland, which are downflow rectangular filters in separate structures.

Brief Descriptions of Installations

The Denver plant contains six magnetite filters, 12 x 204 ft. Has filtered flows up to 50 mgd. Present average flow, 36 mgd. Solenoid, wash water pump and carriage drive operated by direct current from a 20 kw motor generator set for each pair of beds. Settled effluent is discharged onto the filter along one side, passes through it, and leaves over an effluent weir along the entire length of the other side. The cleaner is set to start when the difference between elevation of liquid over bed and that over effluent weir is 5½", the difference being 3" when the bed is clean. Current used by one motor averages 13.2 kw during operation of cleaner, which averages about ⅛ of the time at the present flow of 36 mgd. The average power therefore averages 9 kwh per mg; estimated to be 12kwh per mg with the design flow of 54 mgd and cleaner running about 60% of the time.

Roller seals in front and rear, and side seal angles, are used to segregate the travelling wash compartments from the unfiltered liquor, thereby aiding the maintenance of a backhead between the filtered effluent channel and the wash water compartment for washing the dirty magnetite. The wash water is pumped into an elevated trough and flows back to the head of the plant by gravity. The wash water pump has a capacity of 350 gpm but now operates throttled. These filters are designed to follow a



Flow diagram of chemical dosing and wet sludge conditioning.

2-hr. settling period, which during the growing season is preceded by addition of chemicals, mixing and flocculation.

At Minneapolis 8 downflow magnetite filters are under construction, each 16 x 245 ft., grouped in two batteries of four beds each but otherwise similar to the Denver ones. The washwater pump on each cleaner has a capacity of 400 gpm.

Atlanta has an upflow filter 12ft. wide on a 100 ft. diameter tank, receiving effluent from trickling filters (9 to 11 mgd on 2 acres) which has settled in a humus tank which has a detention period of 0.75 hr.

Elmira has an 8 ft. wide upflow filter on each of two 60 ft. diameter settling tanks. Ferric chloride and lime are used during the summer and the filter is used as a strainer on settled effluent during the rest of the year.

At Cleveland, sewage will be settled in Imhoff tanks, then treated by short period activated sludge with reaeration of return sludge. The settled activated sludge effluent will be applied to the trickling filters at approximately double standard rates. Trickling filter effluent will go directly without further settling to three downflow rectangular magnetite filters, each 225 by 16 ft.

Experiences to date operating full-scale plants equipped with magnetite filters at rates averaging under 2 gal. per sq. ft. per min. of plain settled or chemically precipitated effluent, upflow through coarse magnetite, and at 2.0 to 2.5 gpm downflow through fine magnetite, show that 40 to 50% of the solids reaching the filter are removed by it. Effluents containing 30 to 60 ppm suspended solids are being obtained after filtering settled effluent, 15 to 25 ppm from chemically precipitated effluent, and 5 to 10 ppm by straining activated sludge effluents through a coarse magnetite upflow filter.

Rotary Vacuum Filters

A vacuum filter installation consists of sludge pump or bucket elevator, chemical feeders, sludge conditioning tanks, vacuum filter, vacuum receiving tanks, moisture trap, dry vacuum pump, filtrate pump, blower, filter cake conveyor, and sludge cake hopper. Filtering is accomplished through a cloth medium on a drum rotating in a container of sludge. The vacuum causes a layer of sludge to adhere to the cloth during submergence and the water is sucked out as the drum emerges in the air. At the point of filter cake discharge an air blow-back lifts the cake, making possible its discharge by means of a scraper onto a conveyor.

Conditioning chemicals used are ferric chloride and lime, or ferric chloride alone, depending on the characteristics of the sludge to be dewatered. Fresh settled and chemically precipitated sludges are best conditioned with lime and ferric chloride. Activated sludge and elutriated digested sludges are usually conditioned with ferric chloride alone. Digested sludges may be conditioned either with ferric chloride alone or with ferric chloride and lime.

Filters handling sludges conditioned with ferric chloride only are constructed with rubber-coated filter-drum heads, filter tanks and valve caps, copper- or rubber-lined drainage piping, monel supporting screens and wire, and woolen filter cloths. Filters handling sludge on the alkali side, such as raw, chemical or digested sludge conditioned with lime and ferric chloride, are constructed of iron, although compartments are often of wood. Cotton cloths are used for filtering alkaline conditioned sludges.

The following describes several typical Conkey rotary vacuum filter installations now in operation.

At Washington, D. C. four filters, 11ft. 6 in. diameter by 14 ft. face are in operation for dewatering primary digested and elutriated sludge. Each filter has an effective filtering area of 500 sq. ft. Parts of the filter drum, agitator and filter tank coming in contact with conditioned sludge or filtrates are rubber-lined or covered with 3/16" acid-resistant rubber. Woolen cloths are used as the filter medium for filtering with ferric chloride on the acid side. Automatic float devices electrically controlled regulate the flow of sludge to the filter tank. Auxiliaries are built to resist corrosion from ferric chloride. A dry lime feeder is installed as an aid to conditioning, but thus far ferric chloride alone has been used. Vacuum pumps are of the dry, horizontal, reciprocating type. Sludge cake is discharged onto a belt conveyor, automatically weighed, and loaded into cars for disposal on a government farm.

At Elmira, N. Y., two filters, 8 ft. diameter by 8 ft. face, each having 200 sq. ft. of filter surface, are in operation filtering plain settled and chemically precipitated sludges conditioned with lime and ferric chloride. The filter medium consists of cotton duck cloth. Vacuum of 28 inches of mercury is produced by two dry vacuum pumps, reciprocating double acting, single cylinder, water cooled type, having a displacement of 720 cu. ft. per min. at 350 rpm. The filtrate from the filter is discharged into two 23" x 60" steel receivers and pumped out by two 180 gpm 35 ft. head centrifugal pumps. A moisture trap 23" x 48" long with a barometric leg prevents water from getting into the vacuum pump. Two air compressors provide air for blow-back prior to scraper discharge of the cake. Each compressor has a capacity of 79 cfm. at 10 lb. per sq. in. gauge pressure. Sludge cake is discharged onto a belt conveyor which feeds the incinerator.

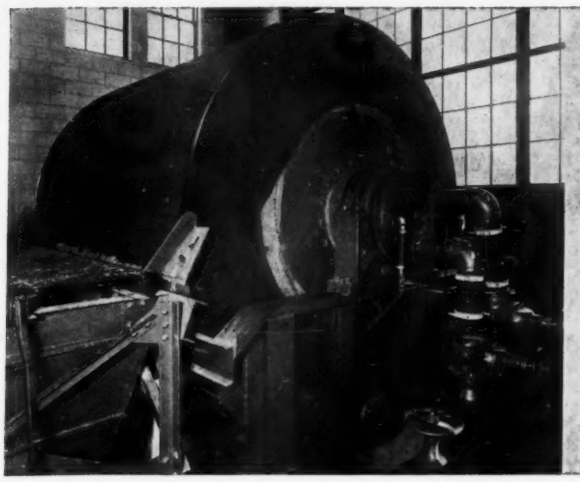
At Auburn there are two filters 10 ft. diam. x 10 ft. face, similar in design and construction to the Elmira filters. Sludge cake is discharged into a hopper and fed to the incinerator through a screw conveyor.

At Neenah-Menasha, Wisconsin, two 8 ft. diameter by 8 ft. face filters are in operation on settled domestic and paper mill wastes. A short period in digestion or storage tank is provided prior to vacuum filtration. Sludge cake is incinerated. Lime and ferric chloride are used for conditioning.

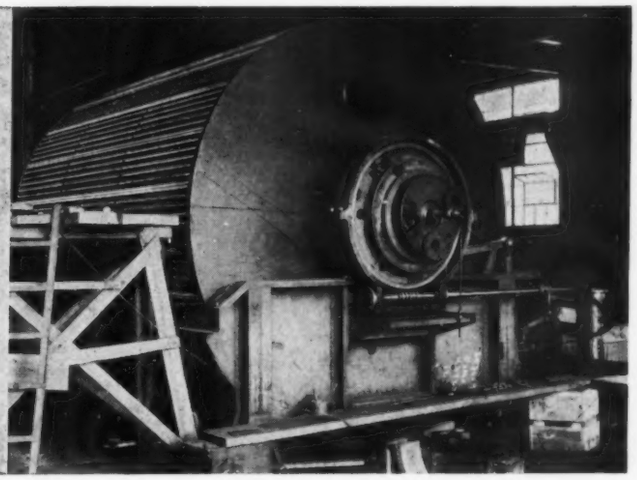
At Perth Amboy the vacuum filter cake is dumped into a deep ravine as a final means of disposal. New Britain, Conn. dewaters sludge from the Guggenheim process on vacuum filters prior to incineration. A filter is used to dewater digested settled and activated sludge at Ann Arbor, Michigan.

At Chicago large vacuum filter installations of the Oliver type are under construction for dewatering settled and activated sludge; Conkey vacuum filters are being installed at Detroit to handle raw settled; and at Buffalo for partially digested plain settled sludge. Other installations are underway but are too numerous to include in the scope of this paper. Ferric chloride alone will be used at Chicago but lime and ferric chloride will be used at Buffalo and Detroit.

Vacuum filter installations in operation indicate a yield of about 5 to 8 pounds of dry solids per sq. ft. per hour for plain settled and chemically precipitated sludges, raw or digested, and cake moistures of 65 to 70 per cent. Amounts of conditioner used average



A 10' x 10' filter at Auburn, showing cake discharge



One of eight 11½' x 14' vacuum filters under construction at Detroit

2 per cent ferric chloride and 10 per cent lime, based on dry solids. Yields from Guggenheim sludge amounted to 4 to 5 pounds per sq. ft. per hour with sludge cake containing between 70 and 75 per cent moisture. Activated sludge mixed with plain settled sludge requires about 5 per cent ferric chloride for conditioning and yields about 3 to 4 pounds dry solids at 75 to 80 per cent moisture. Activated sludge alone yields about 1 to 1.5 pounds at moisture content of 80 to 85 per cent.

Units for Designing

Normally the operating speed of the filter drum ranges from ⅛ to 1 rpm and the agitator from 10 to 15 rpm. Power required for the filter drum and agitator is ¼ hp in the smaller units to 2 hp in the larger sizes. The pick-up vacuum is usually maintained at 26 inches of mercury, while the longer-applied drying vacuum is ordinarily at 20 to 22 inches. Piston displacement of the vacuum pump amounts to from 1¼ to 2 cu. ft. per sq. ft. of filter area. The compressed air amounts to from 0.2 to 0.5 cu. ft. per sq. ft.

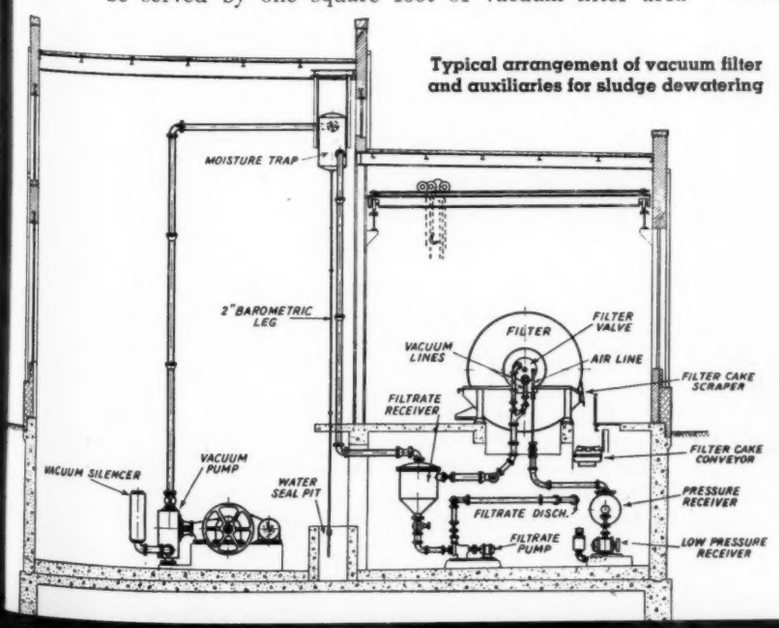
Operating power required for a vacuum filter installation amounts to about 0.08 hp per sq. ft. of filter area. The connected load is usually from 1/3 to ½ higher than the actual operating horsepower.

The size of a vacuum filter installation to be provided for a municipality depends largely on the type of sludge, the spare capacity desired and whether the filter will be operated continuously or part time. The following table shows the number of people that can be served by one square foot of vacuum filter area operating continuously 24 hours per day. This is based on 150 gal. per capita per day and 200 ppm. suspended solids in the sewage.

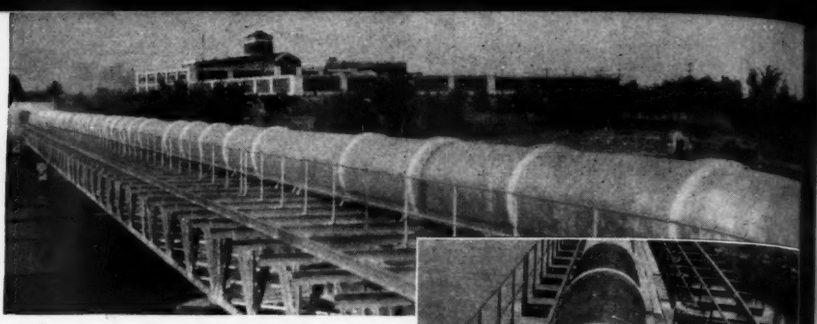
Type of Sludge	*Population on 1 sq. ft. of Vacuum Filter*
Plain settled—Raw	960
—Digested	1280
With magnetite filter—Raw	675
—Digested	900
Chemically precipitated—	450
—With filter	400
Guggenheim	375
Mixed primary and Activated—Raw	320
—Digested	540
Activated alone	160

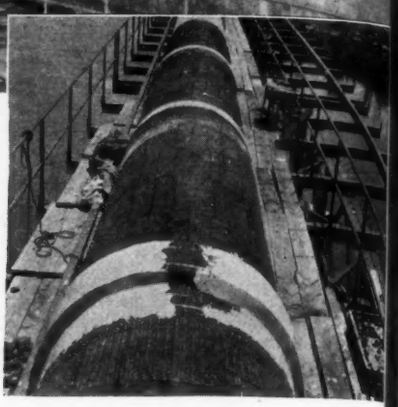
Long-time experience in design capacity on vacuum filters is rather limited for municipalities of 10,000 people and under. Present day practice allows for handling all the sludge produced by using the full available capacity for 6 hours, thereby allowing for starting, filtering all the sludge and washing up during one 8 hr. shift. Where partial or full digestion or storage is provided for wet sludge, one unit installation is sufficient. For raw, plain settled and chemically precipitated sludges with no intermediate digestion or storage, an adequate design would provide two unit installations with capacity to handle all the sludge on one unit during two or three shifts. In preparing sludge cake for incineration, the size of the vacuum filter needs to be co-ordinated with the capacity of the incinerator. Most installations provide a single vacuum pump for one or two unit vacuum filter installations. Larger installations have spare vacuum pumps and other auxiliary equipment. Most of the installations to date have been designed along flexible lines so that either additional filters or auxiliaries may be added as experience indicates.

By the use of mechanical equipment, sewage treatment processes have been speeded up and become more efficient, and plant layouts made more compact. Proper combinations of mechanical devices, chemical reagents and fixed structures with biologic processes come nearer to fitting the needs of the modern American municipality than either one alone to accomplish the entire treatment. It is for engineers to judge in each case which functions can best be accomplished by tanks, by mechanical devices, by chemicals or by biologic methods, and design their sewage treatment plants accordingly.



Typical arrangement of vacuum filter and auxiliaries for sludge dewatering





Water for the City of Ottawa is transported through the water main shown here. To keep water in this pipe from freezing during the severe cold of Canadian winters, two layers of rock cork insulation have been applied to the main, as shown below at the right.

Protecting Exposed Water Mains From Freezing

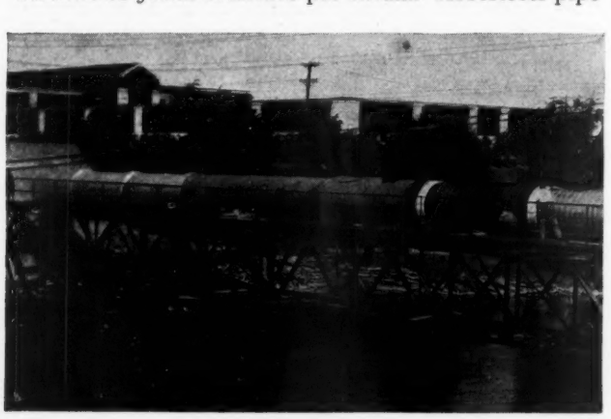
OTTAWA, Canada, obtains an abundant supply of water from the Ottawa river. Although soft, it of course needs filtering, and the purification plant is located on an island separated from the city by a channel of the river over 600 ft. wide. For many years the entire supply was carried through dual pipe lines suspended on a concrete highway bridge; but as the bridge, which was built in 1918, grew older, a feeling arose that additional precautions should be taken to safeguard this arrangement.

Therefore, during the latter part of 1936 and the early part of 1937, an auxiliary water main, 48″ in diameter, was constructed from the filtered water reservoir at the water works to a point some 2,200 feet distant on the mainland, where it connects into the existing 51″ low pressure pipe line.

For about a third of its total length—or 619 feet—the new pipe line, which is steel-cylinder concrete pipe lined with cement placed centrifugally, is carried across the river channel on a steel structure which was erected especially for this purpose, and upon which provision has been made to carry a second water main to be laid sometime in the future.

Many phases of this construction work and of the installation of the pipe line are interesting, but the most unusual part of the story is found in the measures taken to protect the pipe from the extremely low temperatures of Canadian winters.

Before any insulation at all was applied to the water pipe, 1¼″ steam lines were placed to either side of it, and these steam lines were then covered with half-sections of Johns-Manville pre-shrunk Asbestocel pipe insulation placed so as to leave the portions of the steam lines next to the water main uncovered.



"Still water in this pipe line will not freeze during a six-hour period at an atmospheric temperature of 30 deg. below zero"—states the guarantee.

When this insulation for the steam lines had been securely wired in place, all of the pipes were next wrapped up together in a layer of high-rib expanded metal of sufficient strength and rigidity so that an air space would be formed between the barrel of the water main and the J-M rock cork insulation which was to come later.

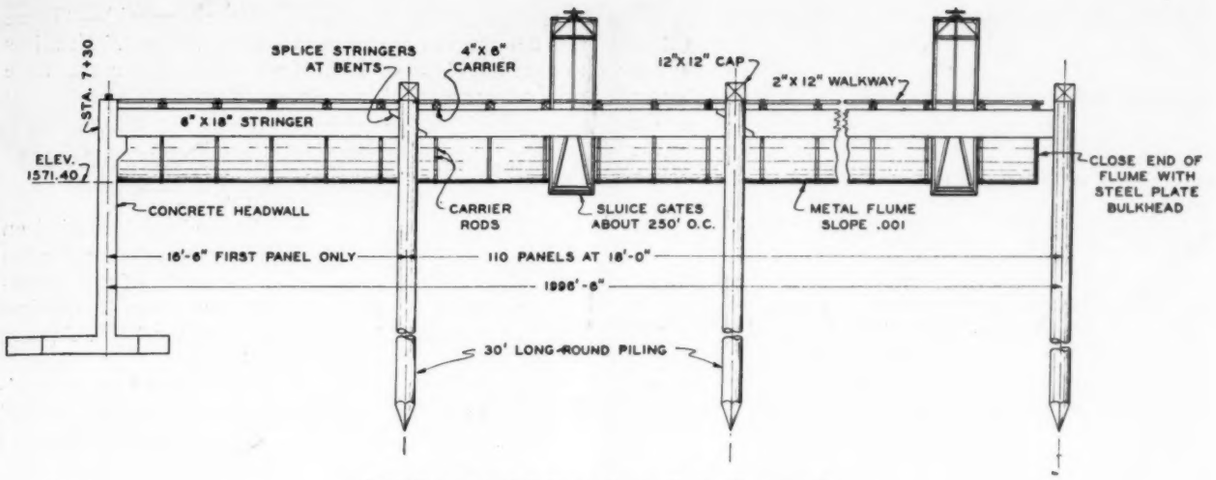
Over this metal, two layers of rock cork were applied, with all joints tightly butted and placed so that none of the joints of the outer layer coincide with those of the inner layer, either horizontally or transversely. The rock cork was held in position with ½ in. wide Signode strapping spaced 12 in. apart. Over the rock cork was placed a ½ in. wire mesh to which was applied a coat of asbestos cement felting with a minimum thickness of ¼ in. and over this was placed a coat of plastic asbestos asphalt weatherproofing compound with a minimum thickness of ¼ in. and so compounded as to withstand the action of the weather and to resist drying and cracking. This coat was finished with a trowel to leave a smooth surface.

The insulation contractor guaranteed the elasticity of the weatherproofing coating; that the insulation was sufficient to prevent still water in the pipe from freezing during a six hour period under minimum weather conditions, at an atmospheric temperature of 30 deg. F. below zero; and that no ice formation will take place on the interior walls of the 48 in. steel cylinder concrete pipe during any period in the winter season when a minimum flow of 4 million gallons per day is maintained. All guarantees made by the insulation contractor are independent of the use of the steam line that was inserted in the air space.

The steam line was placed there by civic forces and is an added protection to the city. Thermometers have been inserted into the air space around the pipe line and readings may be taken to determine the temperature of the air space. The steam line has been connected to a low-pressure steam boiler and vacuum return pump so in case of need the air space surrounding the large pipe can be heated.

Upon completion of the insulation contract the pipe line and pipe-carrying structure was painted, by civic forces, with an aluminum paint.

The plans covering the development and installation of this project were formulated by the late A. Douglas Stalker and were under the direct supervision of W. E. MacDonald, city water works engineer, with C. T. Heeney engaged as resident engineer of construction.



Elevation of metal flume, Loup River silt removal.

Silt-Eliminating Flume for High Silt Content Water

OF special interest to water and power men who have to deal with water of high silt content is an installation recently made near Columbus, Nebraska, the Loup River Public Power District project (commonly known as the Columbus project), which was financed by means of a construction loan obtained through the Federal Emergency Administration of Public Works. Its principal features are described by the following paragraphs and abstracts from reports by Fred C. Albert, supervising engineer:

The Loup River Public Power District project comprises a low control weir across the Loup river to permit the diversion of water into a settling basin; a high line canal through which the water so diverted is carried to the Monroe power house; a low line canal which carries the tailwater of the Monroe power house to a regulating reservoir; a supply canal from this reservoir to the Columbus power house, and a tailrace canal through which the tail water of the Columbus power house is led back to the river. The headworks are located about 5½ miles southwest of Genoa and the tailrace outlet 4 miles southeast of Columbus, Nebraska. The canal system has a total length of 33½ miles, from a river elevation of 1572 at the headworks to an elevation of 1410 at the outlet.

The problem of the disposal of silt carried by the waters of the Loup river had been given intensive study by the district engineers ever since the power project was conceived. They had developed (and afterwards rejected) various plans for reducing the silt and sand in the water to the low percentages required; had held conferences with the engineers of the Reclamation Bureau at Denver, Colorado; studied reports of similar experiments in India and Germany; consulted manufacturers of mechanical filters, and considered various schemes submitted by firms experienced in this type of work. A board of eminent consulting engineers, after a brief study, recommended a procedure almost identical with that already considered and rejected; as did an experienced engineer specially delegated to study the problem. In the fall of 1934 a series of experiments were made in cooperation with the Bureau of Irrigation Investigation of the Department of Agriculture in their experimental laboratory at Fort Collins, Colorado, using actual silt taken from the river. These were designed to show: 1st. The mechanical analysis of gradation of the silt. 2nd. The distribution of silt as a function of depth for various velocities. 3rd. The rate of settlement of silt as a function of velocity of flow. 4th. Use of various mechanical devices designed to accelerate the settlement of silt.

Meanwhile the District's engineers, continuing their studies, evolved a new plan which met the approval of all. It was simple in design, inexpensive and yet possible of extension, should conditions warrant, to

Top—Headworks flume—showing outlet door. Bottom—Sludge flume and headworks.

include the best features of all the plans which had been suggested. This plan consisted essentially of a low diversion weir across the river in order to present the least possible obstruction to the natural flow, headgates built with a sill elevation somewhat higher than the sluice gates immediately below, this in order that the bed load of sand might not drift into the canal. A settling basin 200 feet wide, sixteen feet deep and 10,000 feet long in which the velocity of flow is kept to a .75 foot per second or one-third the velocity in the main canal. Experiments indicate that 75% of the silt and all of the sand bed load of the water will be deposited in the settling basin. Due to the high velocity obtaining in the canal and the extreme fineness of the suspended silt, no appreciable amount of sedimentation is expected.

The silt and sand deposited in the settling basin is removed by a floating, 28-inch suction dredge, electrically operated with power furnished from the District's plants. (Similar dredges are operated by the U. S. Engineer Dept. on the Missouri and Mississippi rivers.) It discharges 70 cubic feet per second of water with 12% concentration, or 1,100 cubic yards of material per hour. Assuming the silt to deposit according to the previous analysis, there will be approximately 10,000 cubic yards of material to be removed daily or about nine hours' work for the dredge. This silt will be distributed along two or more miles of the north bank of the river, between it and the basin, either by direct discharge over the south bank of the basin or through concrete and metal sludge flumes. This will continue until all available space is filled, thus reinforcing the bank, which will protect the settling basin during high waters. It will take some time to fill all the available space; during flood stages some of the material probably will be carried down the river; however, if continued indefinitely, the deposits remaining here would undoubtedly cause the stream to change its course to the opposite bank; and it is important to keep the main stream along the north bank to eliminate the silt.

The metal flume referred to above starts 400 to 500 ft. below the settling basin and has a total length of 1996.5 ft. with a slope of 0.001. The capacity is 25 cfs. It is semicircular, 8.9 ft. in diameter made of 12-gauge galvanized Armco iron in 18 ft. panels, of which there are 110, and a deflection joint of 11° 27′. Standard sluice gates are placed 250 ft. apart. The substructure is of creosoted timber, with the caps of the piles, which had to be cut off during erection, protected with zinc caps. A concrete headwall serves to connect the metal flume with the concrete flume.

The flume design and erection were under the supervision of the Hazra Engineering Company. The installation was made by the John Kerns Construction Company.

Mysterious Phenol Taste Accounted For

An Illinois water plant operator has been bothered by complaints of chlorophenol tastes in the water reaching the consumers, although chemical tests revealed no phenols in the raw, settled or filtered water, and applying chlorine to the raw water produced no "medicine taste." After thorough investigation the mystery has been solved. Chlorine is applied to the filtered water as it passes to the clear well. This well is covered with a tar roofing paper and, due to temperature differences of the air outside and inside the clear well, condensation occurred and a "tar distillate" entered the clear well and chlorination only was needed to produce the disagreeable tastes. As one superintendent said—"There was too much of the wrong kind of overhead." Needless to say, the clear well will be covered with a non-taste producing material in the near future.

Recent Work at the Lawrence Experiment Station

BRIEF summaries of experimental work carried on during 1937 at the Lawrence Experiment Station and the Water and Sewage Laboratories of the Massachusetts Dept. of Public Health are given in the first quarterly report of that department for 1938. Among the most interesting are the following:

Analyses showed that rubber in several waste products from a rubber factory discharged into a municipal sewerage system resulted in deposits on the stones of the trickling filters.

Tests on a tannery sludge showed that this sludge alone would not digest with evolution of gas, as is the case with domestic sewage sludge.

Experiments with digester liquors from a bleachery show that after carbonating with flue gas bacterial growth becomes active and that filtration through crushed stone at a rate of one million gallons per acre daily is practicable.

Studies made of the methods of operating sand sewage filters and of the comparative efficiencies of sand filters of different depths showed that intermittent sand filters should be dosed regularly each day rather than to add twice the dose every second day or three times the amount each third day. A depth of three feet of sand seems to be sufficient.

A study of the effect on sewage disposal of very high rates of operation of trickling filters, using two crushed stone filters and one filter of perforated tile, showed that there is a tendency for the stone filters to clog due to failure to unload as a filter operated at a normal rate does. The effluent is very turbid and the purification considerably less than that from filters operated at conventional rates.

Analyses of air from the interior of one of the crushed stone high rate trickling filters showed that during normal operation the air contained about 15 per cent oxygen. As soon as clogging became noticeable, the percentage dropped to a few tenths of a per cent but never to zero.

Ferric sulphate in amounts insufficient to cause coagulation was added to the sewage applied to a trickling filter. Passage through the filter cause the iron to coagulate. The results show that the effluent is improved, but there is a tendency for the precipitated iron to clog the filter.

Experiments to determine the effect of the addition of ground garbage to two small house septic tanks and an Imhoff tank in amounts equal to the suspended solids in the sewage, on the dry basis, showed that garbage was successfully disposed of in these tanks without detrimental results.

Experiments with the de-aeration of water by means of a partial vacuum showed that satisfactory de-aeration cannot be obtained by means of a partial vacuum alone but that a partial vacuum with agitation of the water is more efficient in removing dissolved oxygen. It was found that a partial vacuum alone was moderately successful in removing carbonic acid from the water but that a partial vacuum plus agitation of the water was more effective.

More detailed information about these studies may be obtained by writing Arthur D. Weston, chief engineer, Dept. of Public Health, Boston, Mass.

Above, divided lane highway in Montecito; below, 42-ft. plant mix approach to Golden Gate bridge; right, the road-mix surfacing on the Feather River Highway.

Pavement Construction Progress and Records

CALIFORNIA has, for some years, been issuing interesting and valuable data on progress in pavement construction. Summaries of these have appeared each year in PUBLIC WORKS. Herewith are reports for 1937, as summarized by Earl Withycombe, Ass't Construction Engineer, in *California Highways and Public Works*, official publication of the Division of Highways.

Strengthening of the foundation for the roadbed and pavement continued to be given primary consideration during the 1937 construction season. The treatment of embankment foundations has in nearly every case proven successful in the severe test of the past winter, during which many failures occurred in older work. Wherever possible, suitable subgrade material is selected within the limits of the project, the only added expense involved being sometimes the additional haul that is involved.

Portland Cement Concrete Construction Methods

During 1937, the Johnson drag finisher (see PUBLIC WORKS, Vol. 68, No. 4, April, 1937) was improved in design, and was used in finishing the project with the record smoothness for the season. This project has a reading of 3.5 inches per mile, which is but 43 per cent of the average for the year, and is the lowest average roughness of any pavement yet recorded since California adopted measures to rate surface smoothness.

This drag finisher consists primarily of a 20-foot frame from which are suspended two 18.5-foot lengths of floatboard crossed under the center of the machine. On three sides of the intersection are mounted V-sections of floatboard, two transverse and one longitudinal, with ready adjustments to the overhead frame. At the opposite end of the frame from the longitudinal V-section is mounted an 8″ roller. The drag finisher is reversible and is operated in both directions without turning. Ordinarily, six trips over the pavement are sufficient for finishing. The steel shod cut-float is used for the final finish and practically all of the cutting necessary consists of shaving off the material pushed up in the joint edging operations. The uniformity in surface smoothness on a concrete pavement finished by this method is quite remarkable.

Graphs of Pavements

Through the courtesy of the Los Angeles County Road Department, graphs were taken of the surface obtained on typical pavements finished by the usual standard methods and by the use of the drag finisher. Their roughness measuring equipment records the variations of the middle point of a ten-foot length of pavement from a straight line between the two end points as shown by accompanying typical sections of the graphs.

Three trips are made over each pavement lane to indicate the roughness along the center line of the lane and along each quarter point line. The upper set of three readings shown in the illustration was taken on a project finished by standard methods with a roughometer reading of 8.4 inches per mile, and the lower

Roughness graphs on two pavement sections

set of three readings was taken on a section finished by the drag finisher with a roughometer reading of but 3.3 inches per mile.

Recent improvements in the construction of finishing machines has made the requirement of more than one machine unnecessary for maximum productions, and future specifications are being revised in this respect.

Joint construction and intervals between joints remain the same as heretofore with ½-inch width of premolded joint material at 60-foot intervals and weakened plane transverse joints at 20-foot intervals. No positive method has yet been perfected to hold the expansion joint filler normal to the pavement surface throughout the finishing operations. Constant vigilance is necessary to accomplish this result.

Construction Records

One outstanding project holds the record for 1937 for maximum average daily output, strength of concrete, and surface smoothness. A contract on Hampshire Avenue established an average output of 465.7 cubic yards of concrete per day, an average compressive strength of 5,813 pounds per square inch, and an all-time record was made on surface smoothness of 3.5 inches per mile, with the use of the Johnson drag finisher. J. E. Haddock, Ltd., was the contractor, W. D. Eaton, the resident engineer, and H. D. Johnson, street assistant. It is indicated on later work that the Johnson drag finisher is capable of producing a surface smoothness superior even to that produced on this project.

The average daily concrete pavement output for the entire state during 1937 was 396 cu. yds., compared to 386 cu. yds. in 1936. The average compressixe strength for Class "A" concrete pavement laid during 1937 was 4,470 pounds per square inch, as against 4,550 pounds in 1936.

The average surface smoothness for the state during 1937 was 8.2 inches per mile compared to 12.1 inches in 1936.

The record for cement control, with an average variation of 0.28 per cent, was made by Matich Bros., contractors, F. B. Cressy, resident engineer, and G. H. Lamb, street assistant. The average variation in cement control for 1937 was 0.81%, compared to 0.85% in 1936.

Asphalt Concrete Construction Methods

During the 1937 season, an experimental section was constructed south of Bakersfield, using asphaltic cement of a much higher penetration than the usual standard of 40 to 60; 2,540 lineal feet of surface was laid with 70 to 80 penetration asphalt, 2,350 lineal feet with 110 penetration, 2,635 lineal feet with 160 penetration and 3,910 lineal feet with 90-95 road oil.

It was necessary to revise the rolling procedure on the sections in which the softer grades of asphalt were used, but this did not materially complicate construction methods, and the surface smoothness of the experimental sections compares favorably with the standard sections.

Since the use of asphaltic cement of higher penetrations is increasingly evident in asphalt concrete pavement construction, the department is adopting ranges of 71 to 85, 86 to 100, and 101 to 120 penetration, for future work.

Compensation in the asphalt content is being made for the asphaltenes as indicated in the petroleum ether solubility test, and this correction has resulted in a uniformity in mixtures that was impossible to obtain under former methods. These corrections will be continued with the softer grades of asphalt.

Construction Records

The maximum daily output of asphalt concrete, and the highest average stability of surface course mixtures were obtained on the San Mateo to Redwood City road.

An average of 805 tons of asphalt concrete were laid per eight-hour day, and the average stability of surface course mixtures was 45% on a job near Redwood City. Basich Bros. were the contractors, F. W. Montell, the resident engineer, and E. W. Herlinger, the street assistant. The average daily output for the state during 1937 was 550 tons, compared to 447 tons in 1936. The average stability of surface mixture was 36% during 1937.

The densest surface mixture was placed between Biola Junction and Herndon, in which the average relative specific gravity was 97.6%. Union Paving Company was the contractor, F. W. Howard, the resident engineer, and E. Thomas, the street assistant. The state average was 94.6%, compared to 94.3% in 1936.

The record for surface smoothness was secured on the road, Willows to Artois, in which the average roughness was 8.2 inches per mile. N. M. Ball Sons were the contractors, J. C. Womack, the resident engineer, and J. G. Mehren, the street assistant. The average smoothness for the state was 15.5 inches as compared to 14.7 inches per mile in 1936.

A slightly greater mileage of plant-mix surface was laid in 1937 than in previous years, there having been constructed 120 miles of this type as compared to 82 miles in 1936. 109 miles of road-mix surface were placed in 1937 by this department, compared to 126 miles in 1936.

The record for surface smoothness of plant-mix, 7.5 inches per mile, was made on the Lake Hodges to Escondido road; R. E. Hazard & Sons were the contractors and L. E. Liston, the resident engineer. The average roughness for the state in 1937 was 28.6 inches per mile as compared to 33.5 inches in 1936.

The record for smoothness of road-mix, 12.6 inches per mile, was made on the Farallone City to Rockaway Beach road. Granfield, Farrar & Carlin were the contractors and H. A. Simard, the resident engineer. The average roughness for the state in 1937 was 31.6 inches per mile as compared to 30 inches in 1936.

The Editor's Page

There's Still a Penalty for Diversion

Some highway officials and others interested in the subject of highway funds have felt concern because the Joint Conference Committee, in coming to an agreement on the 1940-41 Federal aid for roads, struck out Section 12 relating to penalties for diversion of highway funds by states, fearing that this left the door open for such diversion. But according to the American Road Builders Association that fear is groundless. Said Charles M. Upham, Engineer-Director, a few days ago: "It is correct that this section has been stricken from the Bill by the Joint Conference Committee, but inasmuch as this measure is based on the Act of July 11th. 1916, *'and all Acts amendatory therof and supplementary thereto,'* then section 12, of the Act of June 18, 1934, is applicable to RH. 10140, and the penalty for diversion will be invoked in accordance with that section."

Get Your PWA Application at Once

Without waiting for final approval and signature of the bill putting the new PWA program into effect, Administrator Ickes has authorized PWA regional offices to receive applications for new projects at once. States, cities, towns and counties are advised to submit their requests without delay to the offices at New York, Chicago, Atlanta, Omaha, Fort Worth, San Francisco and Portland, Ore.

More than 2,000 applications have already been examined and approved, and the sum available for allotment is definitely limited; so it behooves those who wish a part of this sum to get their applications in at once. The Administrator gives assurance that, once the applications have been received, consideration of them will be speedy. The necessary preliminary work in some cases take more time than is anticipated, and actual work must be started before next January.

If you wish to benefit, get in touch with your regional office *at once*.

A Market for Pumps

We have been aware for several years that water departments were having difficulty in raising the funds necessary to keep their plants in an adequately efficient condition; but a report just issued by the Department of Commerce has startled us. Through PWA and WPA many water departments have been able to increase their storage and distribution systems, but buying and installing new pumps give little employment to local labor and have not been so popular. This possibly is why pumping capacity has fallen below the limit of safety in so many cities.

The report referred to analyzes water works conditions in the 486 cities of 20,000 population and over, as of January 1, 1937. Omitting 100 which did not report or which have gravity systems, we find 75 (19%) report that they have no reserve pumping capacity to meet any increase in demand; and an additional 8% have capacity sufficient to supply an increase of 20% or less.

There are about three times as many municipalities of between 5,000 and 20,000 population, and presumably conditions as to pumping capacity are at least no better among these than among the large cities. That means that at least 25% of the municipalities of the country should increase their pumping capacity at once. What percent of the existing pumps are approaching the danger point in wear or have passed the uneconomical point in obsolescence it is impossible to estimate. But, in view of the difficulty departments have in getting new pumps to maintain a safe capacity, and the difficulty in persuading non-technical commissioners of the desirability of scrapping machinery just because it costs twice as much to operate as would more modern types, it would seem to be conservative to guess that 25% of the pumps now in use should be discarded or retained for a reserve only. This means that cities should purchase as soon as possible at least 50 percent as many pumps as are now in service.

Pump manufacturers would be doing a service not only to themselves but also to hundreds of municipalities if they would find out which ones are in this dangerous or uneconomical condition as to pumping equipment, and furnish the superintendents with facts and arguments to aid them in securing funds for remedying this condition.

Summer Resort Sanitation

The great summer resort areas, such as those throughout the Catskills in New York State, offer a tremendous problem in sanitation. To a large extent this problem centers in the unincorporated villages where, with no legal entity to work on, the Board of Health can do little more than proceed under the old nuisance laws. The problem is further complicated by the fact that these resort areas are only a 2-month proposition, and the hotel owners, usually living elsewhere, object to being taxed for 12-month sewerage facilities.

Under the laws of most states it's possible to require the formation of sewer districts, and the construction by them of sewer systems and treatment plants. The resulting tax rate is usually not prohibitive. Vigorous work by state boards of health is the only way to remedy this condition and to make non-resident owners carry their share of the cost for caring for the wastes they produce.

Play Showers to Cool Children

Last year many of the plants of the American Water Works & Electric Co. mounted a spray nozzle on a truck, provided connections to hydrants and furnished "play showers" for the children in the more densely populated sections of their communities. In Birmingham, the company provided 40 such showers.

Not only is this a worthwhile activity during the hot weather, but it no doubt tends to make the water departments more popular and encourages and promotes good will and better public relations.

So far, in the East there hasn't been much weather to encourage outdoor bathing, but by the time this reaches our readers, temperatures may have risen. At any rate, it is a good idea, and worthy of plenty of copying.

West view of pump house

Two 500,000 gal. steel reservoirs

No. 1 Well house

Modern Equipment Reduces Pumping Cost

By H. J. GRAESER
City Manager, Marshall, Texas

THE consumption of water by the city of Marshall, Texas, has increased rapidly during the past few years, as shown by the following figures:

In 1917 it was 85,000,000 gallons
In 1927 it was 165,000,000 gallons (94% increase)
In 1937 it was 251,000,000 gallons (52% increase)

This is practically all domestic consumption plus that used by manufacturers of ice, etc.; unfortunately some of the largest consumers, such as railway shops and large manufacturers, have reservoirs or wells from which they obtain a large part of their supply for steam purposes.

This increase emphatically indicated to the city commission that a new source of supply and increased facilities were necessary if the city was to have an adequate supply during the next 20 or 25 years.

The supply in 1936 was drawn from wells and pumped from three of these by electrically driven deep well centrifugal pumps, and from ten others by means of air lift, the air being compressed at a central plant by a large compressor operated by steam using natural gas as fuel. This water was delivered to the city by electrically driven centrifugal pumps, supplemented in peak seasons by steam pumps.

Use of a surface supply by means of a reservoir was found to be impractical, and we concentrated on the plan of using additional wells in close proximity to the city. Test holes were drilled in numerous places, one to a depth of 1,000 ft., and a productive water sand was found within the corporate limits between depths of 264′ and 480′.

Plans were made to provide two 500,000 gal. tanks, erect a third high tower of 500,000 gal. capacity, lay 7,647 ft. of 12″ and 33,426 ft. of 10″ delivery mains, and flow lines from three new wells ranging from 6″ to 12″ for a distance of 6,264 ft.

The quality of the water was found to be even better than that from the original wells, which had been slightly acid, with a pH of 6.3, the new supply being neutral with a pH of 7.4, and a lower mineral content.

The original estimate for the contemplated improvements was $180,000, which provided for concrete collecting basins estimating the cost at $36,000; but steel tanks were finally decided upon at the cost of $19,000; by which saving and several fortunate purchases the entire project was financed on a $160,000 bond issue. Three wells have been completed, one is now under construction and a fifth well is contemplated within the near future.

A new contract was entered into with the Southwestern Gas and Electric Company whereby the power rate was reduced from 1.22 cents per kilowatt to 1 cent per kilowatt flat rate without demand charge. The average cost of water from the old plant delivered in the high towers in the city was 5.557 cents per thousand; the new plant, which is entirely electrified with the use of centrifugal pumps, is putting water in the tanks at 2.44 cents per thousand gallons, giving a saving on power alone equal to almost twice the total interest charged on the bond issue.

Standpipe Supplements Pressure-Reducing Valve

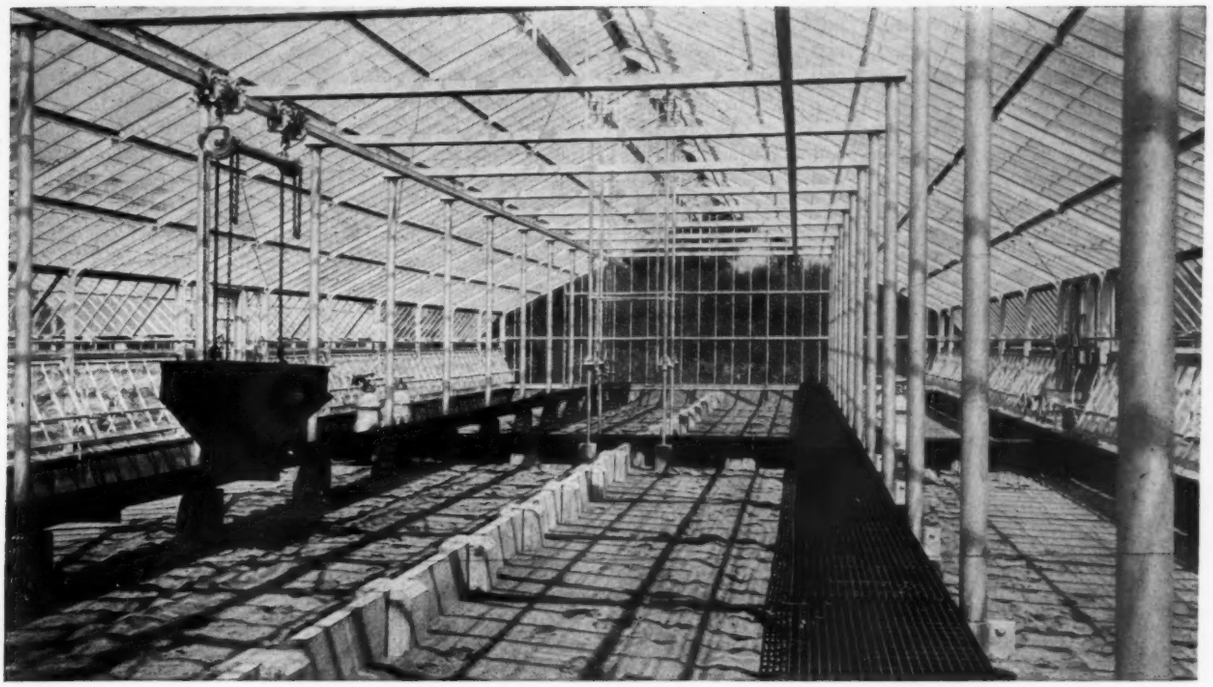
By H. S. PECK
Commissioner of Water, Public Property and Engineering

IN 1936 the city of Fort Smith, Ark., secured a new water supply from a lake in the mountains 23 miles north of the city. The supply is filtered at the lake and brought in a line of steel pipe 27″ diameter and 5/16 in. thick, reaching the edge of the town with a pressure of 145 pounds.

The town is divided into three service districts. The highest of these receives the water without having the pressure reduced. At the extreme opposite side of this district is a reservoir that floats on the system.

In part of the second district, which includes the business section and most of the residences, the static pressure would be 150 pounds. In order to reduce this, an automatic valve was installed which was supposed to hold the pressure close to 70 pounds. However, it failed to do this and we had a large number of blowouts in our cast iron mains.

To remedy this, last summer we constructed a standpipe at the side of the town opposite from the control valve. This standpipe floats on the system, and has near the top an overflow which operates when the pressure exceeds that arranged for. This overflow discharges into an 11,000,000 gallon reservoir built near it. This reservoir gives us an emergency supply, available for any time when we might have trouble on our main from the filter plant. In order to keep the water fresh in the reservoir, a small section of the town nearby which is lower than most of the remainder was made into a third district and fed directly from the reservoir. Since the construction of this standpipe we have had no blowouts.



Interior of sludge drying bed, Massillon

Building Trunk Sewers and Sewage Treatment Plant

By C. E. RICE

City Engineer of Massillon, O.

DURING the latter part of 1937 the city of Massillon, Ohio completed and put into operation additions and improvements to the sanitary sewer system which included the construction of two miles of trunk sewers and a treatment plant. The program was carried out as a Public Works Administration loan and grant project, docket O. H. 1058 R under the 45-55 split proposition.

In 1923 a study was made of the sanitary sewer system, followed in the next two years by the building of several miles of trunk sewers. At that time, with approval of the State Board of Health, the raw sewage was temporarily emptied into the Tuscarawas river near the lower end of the city; the city, however, obligating itself to complete the sanitation program by building a disposal plant when the State board requested this to be done. In 1933, when the government was promoting public works construction, the State Board of Health asked the city to construct a sewage treatment plant, and trunk sewer connecting the existing outlets to such plant.

George B. Gascoigne and associates of Cleveland, Ohio, were employed as consulting engineers on the treatment plant, the city engineering force taking care of all field operations both preliminary and during construction. The technical work on the design and construction of the trunk sewers was handled direct by the city department.

C. E. Rice

The main interceptor trunk sewer, about 1½ miles long, was built of brick, 66″ to 54″ circular, 2-ring and 3-ring type, with two inverted syphons, one of which was 54 feet and the other 315 feet between chambers. The average grade of this sewer was .024 percent, or ¼″ per 100 feet of length. This trunk sewer, connecting the existing main outlets, where they discharged to the river, with the plant, was built along the east bank of the river and, being below water level at normal flow, presented something of a problem to the contractor. The soil was sand and gravel, after the first three feet of bottom land muck was removed. At the start of the job it was attempted to tight sheet the portion to be excavated by driving two inch planking supported by conventional walers and struts, then to de-water the excavation inside the sheeting by use of pumps. The contractor used as many as four centrifugal pumps having a combined capacity of 10 million gallons per day, but this procedure was found to be too slow and costly and a well point equipment was ordered in by the contractor. The well points were about 18 feet long spaced 30 inches apart on each side of the trench and were used in this way for the first one-half mile of work, using a 5 m.g.d. centrifugal pump on the suction header. This was so successful that, although the excavation was in water-bearing sand and gravel, it was not necessary to use sheeting to hold the sides of the trench, nor was it necessary to pump the underdrain at any time, although the latter was put in ahead of

the brick invert as a precaution. After the first one-half mile of work, the well points were used on only one side of the trench—that opposite from the river, showing that the underground water flow was from the hillside toward the river. This brick sewer was built by Garaux Bros., contractors, of Canton, Ohio.

The other trunk sewer was of 24-inch vitrified clay, with bituminous joints throughout approximately one-half mile of its length, with an average grade of .40 per cent. This was built to eliminate the need of maintaining and operating an existing sewer lift station. This portion of the work was constructed by The Shullo Construction Co. of Akron, Ohio.

The plant itself is of plain sedimentation type with separate sludge digestion and drying beds, also equipped with chemical precipitation apparatus to be used during extremely low flow in the river into which the effluent is discharged. The plant is located on low bottom land between the Tuscarawas river, which bounds the plant on the west, and a steep hill side on the east. The site is about 300 feet wide by 1500 feet long and is protected from high river flows by a 12-foot high levee along the western boundary. Provision is made on this site for future installation of activation and sludge clarifying tanks between the primary tanks and the digestors.

The 1930 federal census gives the city a population of 26,400, and the contributing population was estimated at 24,000. Plant design is based on 36,000 with a total flow of 5.2 million gallons per day, using a figure of 144 gallons per capita per day. This latter figure was verified by study of water consumption records and industrial processes served by the sewer system. The storm and sanitary sewer systems of the city are supposed to be separate.

Sewage comes into the plant proper through a gate house equipped with bar grates having a 1½-inch spacing for removal of coarse screenings, which are raked off by hand and buried. This screen chamber is equipped with a direct by-pass to the river, which is controlled by power-operated sluice gates furnished by the Chapman Valve Co.

From the screen chamber the raw sewage flows to a covered wet well alongside the main pumping building, where it is lifted about 18 feet by centrifugal electric operated sewage pumps in order to obtain gravity flow through the balance of the plant. The raw sewage pumps are two 5 m.g.d. and one 3½ m.g.d. Fairbanks Morse equipment (rated capacity), capable of handling trash of 3 to 5-inch spherical diameter, arranged so that any combination of the three, two or only one can be used, and they are cut out and in automatically, depending on the depth of sewage in the wet well. The main pump building is of brick and steel, two stories high with a two-level basement. On the lower basement floor are the raw sewage pumps, also a 1 m.g.d. drainage pump to be used when the wet well is required to be emptied for repairs, etc. Also the fresh water supply pump is located on this floor, connected to a 12" diameter, 85-foot drilled and cased well. The upper level of the basement houses the fresh water tank with automatic air compressors to maintain a constant pressure of water, the boiler room and coal bunker. The heating equipment includes a coal and a gas boiler sitting side by side, with piping to unit heaters and radiators distributed in various rooms of the building. Gas hot water heating equipment is also in the boiler room. The ground floor of the main building provides a mezzanine around the pump chamber, a garage and a flash tank mix room with chemical feed machines. The second floor of this building has a chemical storage room capable of storing chemicals in car load lots together with a ferric chloride mixing tank. This room is equipped with an overhead mono-rail power hoist so that chemicals can be taken direct from truck in the garage on the floor below, raised through a trap door and conveyed to any part of the storage room. The plant superintendent's office is on this floor, as well as a chemical laboratory. In addition, there is a locker room, shower and toilet, with additional closets for chemicals and other supplies storage. The chemical laboratory is equipped with sinks, tables, fume hood, water stills, electric furnace, incubator, balance room and equipment necessary for all analysis work required. The office contains a Bailey recording meter connected to the main discharge line from the raw sewage pumps two floors below, and recording the pumping operations.

From the main pump building the raw sewage goes direct to the primary settling tanks, which are rectangular with sludge collecting equipment, designed to give a detention period of 1½ hours at 5.2 million gallon per day rate of flow. Sludge collecting equipment for these tanks was furnished by the Jeffrey Co., which also supplied a new type of skimming mechanism placed at the outlet end of the tanks. When chemical precipitation is used, the raw sewage, before it goes to the primary settling tanks, is diverted to the flash mix tank located in the south-west corner of the main building, where lime and ferric chloride are introduced, and from this to an outside rectangular flocculating tank where large paddle equipment travels transverse to the direction of the flow of the sewage through the tank. Mechanical equipment in the flash and the flocculating tanks was furnished by the International Filter Co.

From the primary settling tanks the effluent goes by gravity to the river and the sludge is pumped to one of two circular digestion tanks, each of which has a 36,000 cu. ft. storage capacity. These tanks are built with a control room between them, in which is the necessary piping and pumps for sludge receiving and removal to drying beds, also sampling cocks, gas heaters and circulators for heating the coils inside the tanks, gas collecting equipment, meters, flame traps, etc. with unit gas heaters and ventilating mechanism. Pacific Flush Tank floating covers 51 ft. in diameter are provided for the digestion tanks, with the necessary gas collecting accessories. Waste burners on the roof of the control room dispose of such gas as is not used in heating various parts of the plant. The control room is laid out with provision for adding other digestion units when needed by duplicating present units, using the present control room for the whole group of digestors. Supernatant liquor can be removed from the top of the sludge in the tanks by gravity or by pumping and returned to the primary settling tanks.

The sludge drying units are typical Lord & Burnham glass covered houses, three in number, each having four drying beds 18 by 27 feet in area. Space is provided for adding other units as required. The beds are equipped with overhead mono-rail sludge removal units leading out to truck loading slips in the front of each green house. Underdrains from sludge beds drain into a storm sewer, which also receives surface drainage inside the plant site and from the adjoining hillside on the east; which drainage flows through the drainage pump chamber to the river. This drainage line is equipped with an automatic check valve which closes when the river outside the protective levee reaches

a certain level, the drainage water then going over a weir wall to a wet well, from which it is raised by automatically controlled electric centrifugal pumps and discharged to the river.

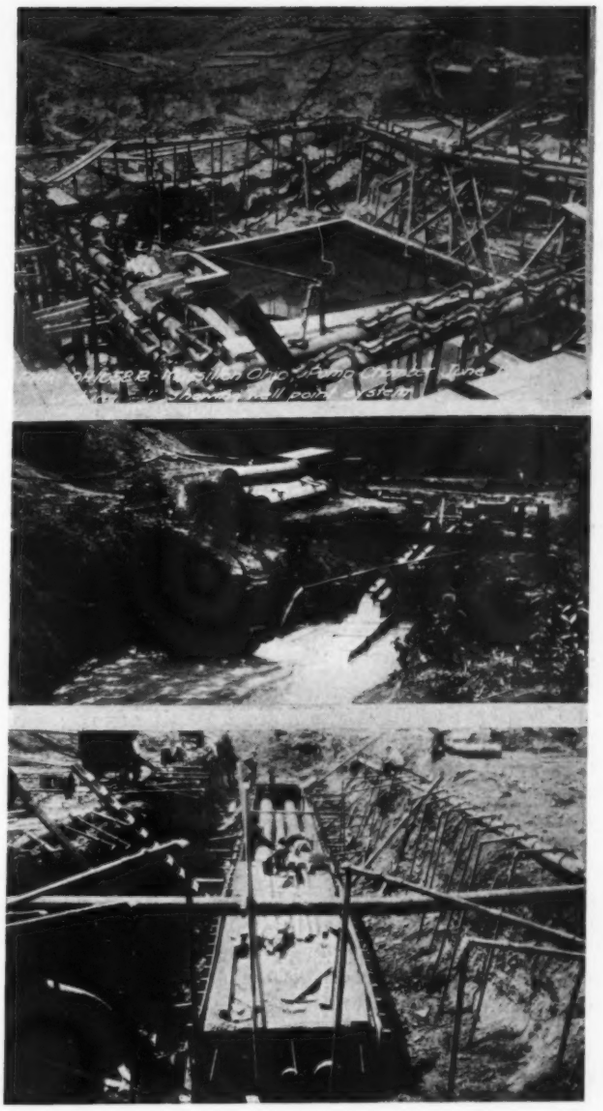
One of the specially interesting features of the construction work was the large amount of ground water that was encountered in the foundation work. It was necessary to resort to a well point system in the erection off all structures with the exception of the greenhouses and flocculation tank. On one substructure it required three rings of well points spaced 30 inches apart around the excavation with three pumps attached with combined pumpage of 10 million gallons per day. This is over three times the average daily rate of pumpage for the city water supply system.

The equipment and all parts necessary to operation were finished so that test runs were started Sept. 1st, 1937 and full time operating began Oct. 1st. Since that time W. P. A. laborers have been working on landscaping, seeding, finishing plant and access roadway about ½ mile long from paved highway, the building of enclosing fence, a three-stall two-story brick garage, and concrete sidewalks about the plant structures.

At the present time The Muskingum Watershed Conservancy District, in collaboration with the federal Department of Agriculture, are installing stream gauging apparatus, rainfall, wind direction and velocity and temperature recording instruments which the city will look after in connection with the operation of the plant. It is expected that the weather data so obtained will be of considerable value in plant operation and records.

No sludge being readily available, when the plant was put into operation, to seed the digestors, raw sludge was introduced and a temporary vertical coal-fired boiler set up and connected to the heating coil circulating system on tank No. 1, in order to furnish heat to get the bacterial action started. Later the heating systems of both tanks were operated by the same outside heat generating unit. After about five weeks of this operation enough gas was obtained from tank No. 1 to start the gas-fired boiler for that unit, and a few days later the other tank was likewise in production, and soon the gas production was sufficient to heat digestion coils, furnish three other unit heaters with fuel, and supply the main pump building with general heat, hot water and gas for laboratory use. Daily gas requirements for these purposes was approximately 23 to 25 thousand cubic feet per day for the past winter months. Production at present is averaging 35 thousand cubic feet per day, with a maximum of 40. Average daily sanitary flow is 2 million gallons per day, with a range from 1.5 to 2 million gallons per day fluctuation.

February records of laboratory analyses show a removal of 70% suspended solids from 264 ppm in the raw sewage. This figure may seem at first to be high for only primary treatment but, the flow being lower than the designed capacity of the tanks, we are obtaining a 3-hr. detention period rather than a 1½-hr. Also, there seems to be a trace of iron salts in the raw sewage



Top—Well point system, pump chamber excavation. Middle—Discharge from well point system. Bottom—Building siphon pipes under river; 15", 12" and 8" lines, bituminous joints, cased in concrete.

which, together with industrial waste from a paper mill, appear to give some flocculating effect in the tanks which is accomplishing some of the results that we expect from the use of chemical precipitation. It is planned to study this latter condition further with laboratory analysis. Records show that during the month of February, 54 tons of dry solids were obtained in the form of sludge. A two-week period of B. O. D. tests in the same month indicated a 50% reduction from raw sewage to final effluent.

Current is obtained from the local power company for power and lights at a primary rate, as the city installed its own transformers. This consumption and cost for the period for October 1st to March 1st is as follows:

Month	*Kwh per million gals.*	*Power bill*	*Aver. cost kwh*	*Cost of power per million gals.*
October	144			
November	150	$140	.018	$2.74
December	162	261	.027	3.21
January	153	158	.017	2.50
February	140	158	.016	2.20

The above figures show quite a fluctuation, which is caused by weather conditions sometimes requiring the operation of surface drainage pumps and, during the extreme cold weather in December, it became necessary to operate the sludge collecting equipment 24 hours a day for a period to keep the skimmer mechanism drive from freezing. Ordinarily this is run only intermittently. Power rates fluctuate with peak demand in the several kwh rate brackets. There are two 1,000-watt flood lights mounted on the roof of the main building to light the grounds and the primary tanks at night as needed, which obviously will consume more current during winter months because of the shorter daylight hours.

The capital charges on the plant and trunk sewers, together with plant and collection system maintenance and operation, are carried by an annual charge against each connection to the sewer system under the Ohio sewer rental law. Operating personnel at present is one superintendent chemist, three operators working eight-hour shifts, and two high-grade laborers, one of which serves as relief operator when necessary and the other looks after trouble calls on the general sewer collecting system and, when not on such work, is generally doing the many mechanical odd jobs that are necessary about the plant. It is estimated that after the coming summer, when the new lawns get in grass, etc., it will require two laborers daily to do the general policing work about the plant site. In addition to the above, two bookkeeper clerks are employed to keep the rental records up to date, take care of billing and collecting each quarter, general bookkeeping and office routine work.

The cost of the entire improvement under this program was approximately $520,000 of which the trunk sewers represented about $176,000, the balance being on plant site and construction. Of the above amount, the Public Works Administration made a grant of $230,000, the balance being a federal loan at 4% per annum interest retired over a twenty-year period.

The construction contract for the plant was executed by the Elmer O. Vogt Paving Co. of Massillon. The consulting engineers making plant design was George B. Gascoigne and associates of Cleveland, Ohio. Public Works Administration resident engineer was J. M. Eakin. City engineer in charge of construction for the city, C. E. Rice, who submits this article. The superintendent chemist who is in charge of operations of the plant is R. F. Snyder, who was formerly connected with Mr. Gascoigne's organization.

Parking, Pedestrians and Traffic Signals

The walking habits of 3,386 pedestrians were observed at signalized street intersections in downtown Detroit. Of this total, 41 per cent began crossing against the red light, but only 53 per cent of these were successful in doing so, the rest being forced to stand in the middle of the roadway between opposing streams of traffic rather than on the sidewalk. Of the 59 per cent who started across on the green signal, 35 per cent failed to reach the opposite curb before the light changed to red. Many of these persons accomplished the crossing without danger, while in the case of others there was confusion and great danger. Only 38 per cent of the total walkers started and finished the crossing on the green light.

Observations were also made to determine the average week-day utilization of street parking facilities in the downtown area of Detroit. Over a 14-hour period from 7 A. M. to 9 P. M. the following data were obtained:

Where parking time was unlimited, the greatest users of space-hours were the cars left standing for a period of 9 hours, obviously owned by persons employed. In this group 156 parkers used 1,404 space-hours, while 1,701 parkers in the 20-minute-or-less classification used but 288 space-hours.

On streets where parking was limited to one hour, the peak utilization was obtained by those who parked for 8 hours and 20 minutes. Visits of one hour or less numbered 21,821, utilizing 6,171 space-hours, while 18,345 space-hours were utilized by only 6,220 visits of more than an hour.

In spaces where parking was prohibited at all times, a total of 11,664 cars were observed. Of this number 10,064 (86.5 per cent) parked for a period of one hour or less, which indicates further that persons whose business can be transacted in a short time constitute the greatest number of parkers. As in the previous observations, however, a few longtime parkers monopolized considerable space, even in these no parking locations, some leaving their cars throughout the entire 14-hour period.

The above data were reported by the Michigan State Highway Department and are taken from Highway Research Abstracts.

Making Surfacings Non-Skid in Germany

Surfacings which have become slippery in wear can be rendered non-skid either by impressing patterns on the surface or (preferably) by the application of surface dressings or thin carpets. An account is given of the methods adopted in Hanover, where many of the roads have compressed asphalt surfacings of a type which readily becomes slippery when worn.

Dirt and oil are removed by burning the surface with a road heater; the surface is scraped, and coated hard stone chippings (0.1 to 0.3 in. or 0.2 in. to 0.5 in.) are spread at once on the softened asphalt at the rate of 18.5 lb./sq. yd. and lightly rolled. This method, which is rapid and inexpensive, has proved satisfactory, and is considered capable of further development.

Alternative methods are: (a) The road surface is cleaned with weak lye and treated with a rapid-breaking bitumen emulsion of high viscosity at the rate of 5.5 lb./sq. yd. Hard basalt chippings (0.12 to 0.2 in.) are then applied at the rate of 26 lb./sq. yd. It is stated that dressings of this type constructed in 1933 were in good condition in May, 1937. (b) A carpet 0.8 to 1 in. thick may be produced by the use of an emulsion similar to that used in (a), at a total rate of 22 lb./sq. yd.; the emulsion is applied in two stages, the first application being covered with hard stone chippings (0.3 to 0.5 in.) at the rate of 55 lb./sq. yd. and the second with finer chippings (0.2 to 0.3 in.) at the same rate. (c) The surface is cleaned with lye and an emulsion prepared on the site in a small mixer is at once applied at a temperature of 80° C. by means of a sprayer at the rate of 1.8 lb./sq. yd. Hard stone chippings (0.1 to 0.3 in.) are immediately spread at the rate of 18.5 lb./sq. yd. and rolled with a medium-heavy roller. A second application of the emulsion at the rate of 1 lb./sq. yd. is covered with chippings (0.08 to 0.2 in.) at the rate of 9 lb./sq. yd. and again rolled. The road may be opened to traffic after 24 to 48 hours. Work of this type should be carried out in hot, dry weather. (d) The surface is heated with a road heater, and a mastic consisting of rock asphalt (produced locally) and stone chippings is applied to the hot surface. Bitumen-coated chippings (0.2 to 0.5 in.) are at once applied and rolled with a light roller.—By M. G. Orthaus, in Bitumen. From *Road Abstracts*.

Recommended Operation of Sludge Digestion Tanks

RECOMMENDED operation procedures for digesters used in connection with sedimentation and separate sludge digestion types of plants have been summarized in *The Digester,* publication of the Division of Sanitary Engineering, Illinois Department of Public Health, C. W. Klassen, chief sanitary engineer, as follows:

In starting a digester, fill with water or sewage and heat to about 80° F. (if heating facilities are available). Addition of seeding sludge to about 25% of the tank capacity, followed by daily charges of fresh volatile solids in amounts not to exceed 3 to 5% of seeding volatile solids, should develop proper digestion. Use lime to control pH if necessary.

Daily charging rates govern digestion "balance." Charging unheated tanks at rates of 1 to 2 pounds fresh volatile solids to 40 pounds of seeding volatile solids, and heated tanks at about twice this rate is suggested.

Frequent, small charges are advised, always avoiding pumpage of excess water with sludge. A proper pumping schedule must suit both settling tank and digester operation. Trickling filter humus and waste activated sludge is best handled by returning to primary tank influent whence it is taken to digesters as a mixture with primary sludge.

Charging rate flexibility is impossible in small plants having a single digester. Small daily doses of lime applied to the upper sludge layer is helpful in raising pH but continued, excessive use may be harmful.

Operation of scum breaking and sludge stirring mechanisms for a short time after raw sludge is added should be sufficient. Facilities are sometimes provided for circulating digester contents to bring actively digesting sludge in contact with fresh solids. Two hours' circulation every two weeks should be adequate normally. Never draw supernatant immediately after agitation of the tank contents.

Separate digesters should produce an overflow (supernatant) liquor of low solids content. Though less than 0.5% of the sewage flow in quantity, a poor supernatant may completely upset the entire plant when returned for treatment with the sewage.

Supernatant overflow is governed by sludge pumping rates to fixed-cover digesters. Other types are equipped with piping permitting a choice of withdrawal level. After sampling to determine the best level, draw supernatant slowly over a period of several hours daily. Never return large quantities to the sewage flow at one time.

Application of activated carbon to raw sewage or fresh sludge added to digesters is reported to clarify poor supernatant as well as raise pH, accelerate digestion and reduce odors. Dosages of 3 to 5 ppm based on sewage flow are recommended.

Temperatures of 70° to 95° F. are maintained in most heated tanks, the common range being 80° to 85° F. "Thermophilic" digestion at temperatures of 115° to 130° F. is practiced in a few plants.

Make pH determination on sludge daily, a reaction of 7.0 to 7.3 being favorable. Definitely acid reactions generally indicate lack of digestion balance and charging rate adjustment should be made if possible.

Small withdrawals of digested sludge at monthly intervals is recommended. Sludge level soundings or volatile solids, determinations on sludge at various depths will indicate safe amounts to withdraw. Digested sludge will contain 35 to 50% volatile matter. Undigested sludge may accumulate during winter in unheated tanks, possibly resulting in digestion upsets in spring. Careful withdrawal procedure is recommended.

Scum formation may be controlled by submerging with circulated supernatant, manual breaking and submergence or by mechanisms. Heavy accumulations should be removed to sludge beds.

Two-stage digestion involves charging all raw sludge to one unit, displacing an equal volume of partly digested sludge to another unit in series. Supernatant is not drawn from the first (primary) stage, therefore agitation in that stage is desirable. Sludge and supernatant separation takes place in the second stage. Higher charging rates are permissible than in single stage operation but if acid conditions result in the primary digester, liming or resting is advised.

Two-stage digestion is not to be confused with plants employing sludge storage tanks, provided to store sludge during unfavorable drying weather.

Foaming and Its Control

Formation of a fluffy, grayish froth accompanied by violent gasification, which froth often cannot be confined to gas vents or within digester walls, is called "foaming." Evidence indicates that loss of balance between fresh solids added and seeding sludge is a common cause. Excessive fresh sludge charges or accumulated undigested sludge through unfavorable digestion periods (as occurs during winter in unheated tanks) may unbalance digestion. Milk, brewery and similar industrial wastes may create acid digestion conditions and cause foaming, particularly in Imhoff tanks. Foaming is usually, though not always, associated with a pH of 6.6 or less.

Much remains to be learned about foaming prevention and control. Some remedies which have been successful, follow:

1. Reduction of daily loading. Complete rest is advisable in severe cases, when other digestion or storage units are available.
2. If drying or lagooning space is available nearly all of the sludge may be drawn and digestion started anew.
3. The addition of lime, which acts somewhat as a "drug," may temporarily abate foaming until digestion reaches balance. If acid conditions prevail the pH should be raised to near 7.0. Avoid over-liming.
4. Application of 3-5 ppm of chlorine to the raw sewage has been successful.
5. A gentle spray of water or supernatant liquor on the foam surface reduces volume and releases gas. Violent hosing is of questionable value.

Surfacing being laid on T-grid flooring of steel bridge. Note all-welded railing

Equipment and System Cut County Costs

By JAMES R. SHUTTS

THE wonders which modern machinery and modern accounting systems can work to help county engineers keep within the limits of a reduced budget has been demonstrated vividly in Mahoning County, Ohio, during the past year, when new high records for total accomplishments in a diversified engineering program were set by county engineer Robert Schomer, who, when elected county engineer in January, 1937, allotted 10 per cent of his $500,000 operating budget to new equipment, and, although he paid the $32,000 debts of a previous administration, finished the year, despite his unprecedented program, with $87,000 still unspent.

ROBERT J. SCHOMER
County engineer, Mahoning County, Ohio.

Acting toward economy immediately after his election, Mr. Schomer quickly put into effect three of his principal "money savers" :

1. Purchase of sufficient subsidiary equipment, besides the $50,000 worth of operating machinery, so the county could operate, maintain and repair its own equipment.

2. Complete elimination of "political deadwood" in the department; strengthening cooperation of remaining employes by a 23 per cent pay increase; ultimate saving of $38,417 over previous year's pay roll.

3. Installation of an accounting system capable of minutely detailed and cross-checked reports to provide a step-by-step picture of production costs.

And here is what the engineering division accomplished with the approximate $270,000 spent in the building program:

	Without WPA	*With WPA*
New road construction	18.05 miles	55.36 miles
Part new road construction	4.95 miles	...
New road surfaces	82.15 miles	...
Part new road surfaces	9.15 miles	...
Sewers, water mains	Misc.	6.38 miles
Drainage ditches	Misc.	11.71 miles
New bridges	3	3
Bridges repaired or altered	5	5
Quarries operated	...	7
Garages built	3	2

This 114.3 miles of new and renewed roads without WPA aid was 25% greater than similar work done in any previous year.

Before Mr. Schomer made a move toward formation of a works program he conferred with the trustee board of every township in the county, believing them more accurately informed of their highway and drainage needs. From these conferences came a schedule of necessary improvements, and on this basis machinery requirements were computed.

Previously, the county had rented equipment on an hourly basis, and the actual physical assets of the engineering department in 1937 were so obsolete as to require writing off. Starting from scratch then, Mr. Schomer purchased:

Universal Lorain, No. 40 power shovel, ¾ cubic yard capacity; five Federal 1½-ton dump trucks; two Mack 1½-ton dump trucks; four Plymouth pickup trucks; two 800-gallon bituminous material distributors of E. D. Etnyre manufacture, one a new Model D-935, the other a reconditioned Model D-56, both on Model E-H Mack trucks; one pickup truck, two carryalls, two coups, one coach all of Chevrolet manufacture; International Harvester tractor with mowing attachment; road sweeper and two Ross snow plows with hydraulic lifts; Rex 10 S concrete mixer; two Galion material spreaders; Hobart Brooks motor and generator for welding; two Ingersoll-Rand air compressors; five Lincoln lubrication outfits; Weaver Twin-Post hydraulic lift; two chain blocks on trolleys; two seven-ton hydraulic jacks.

Enlarged and new garages were needed at strategic points to house the equipment, and they, along with a blacksmith shop for the fabrication of maintenance parts, were built early last year.

The purchase of this equipment freed the county of machinery rentals other than the costs of hiring several extra trucks during the summer—an economical procedure, since the hired trucks are needed for only four

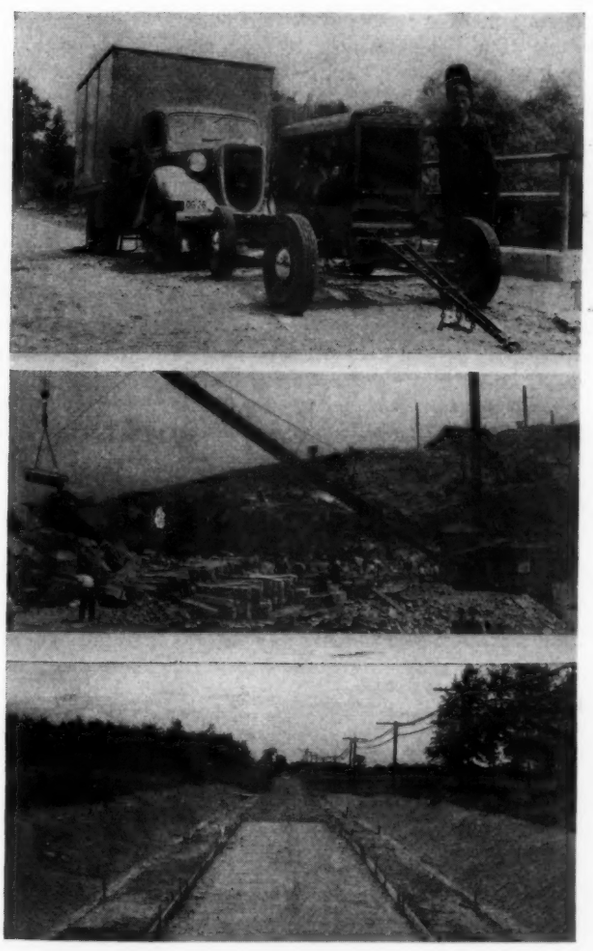
or five months of each year. Particularly large savings were noted through the blacksmith shop installation and the use of a portable welding outfit by a two-man crew of skilled welders. However, construction expense tables shown below compute machinery costs on a rental basis, that being the only standard which Mr. Schomer had available.

In the materials division, prime money savers were the county-leased stone quarries. Seven of these, operated through the WPA, produced stone for road base, foundations and curbing to the mount of 56,400 cubic yards in the year. This stone cost the county $31,780, which included $14,180 set up as "theoretical rental expense" on the use of county-owned equipment.

The individual production quantities of the various types of stone are listed below, together with estimated costs for such material when purchased on the market. Comparison of the totals shows a saving of about $10,000.

52,920 cu. yds. stone for road base @ 35c	$18,520
1,650 cu. yds. block stone @ $4	6,600
305 cu. yds. bridge stone @ $6	1,830
36,680 lin. ft. of curb @ 40c	14,670
	$41,620

General road improvements in the county were done in the most part with bituminous preparations, using stone from the quarries to best advantage on the base for the 20 miles of new highway construction. The surface applied on the new road bases was prepared according to the prevalent road-mix method.



Top—Portable welding generator and tool truck. Middle—One of 7 quarries where road base, stone block and curbing are prepared. Bottom—Showing method of highway construction.

Top—An 18 ft. concrete barrel arch under both road and railroad. Bottom—New piers under old covered bridge.

Including a liberal allowance for equipment charges, surfacing costs are computed at 41½ cents per square yard, or $4.07 per ton. Heavily-traveled surfaces laid early last summer are still in good condition, showing both resistance to the pounding of fast traffic and flexibility to cope with extreme weather conditions and temperatures.

Summaries of the costs and quantities in several types of road surfaces laid last year give an insight into Mr. Schomer's "budget stretching" system.

Surface Treatment

Material used per square yard: Nos. 6 and 46 slag, 20.86 lb.; bituminous material, .35 gal.
Cost of haul per ton mile (assuming a charge of $2 per hour for trucks), $0.1009; average haul, 9.2 miles.
Cost per square yard:

Nos. 6 and 46 slag	$0.0140
Bituminous material	.0315
Labor (includes supervision)	.0067
Equipment (includes hauling)	.0157
Total	$0.0679

In the labor costs given above, the wages of supervisors as well as foremen are included. Hourly wage rates were: 60 cents for unskilled labor; 70 cents for semi-skilled labor; and 80 cents for skilled labor. Equipment costs were determined by using the current hourly rental rates. Assumptions are the same in next table.

Retread

Material used per square yard:
Nos. 1, 2 and 34 slag, 143.33 lb.; Nos. 6 and 46 slag, 46.08 lb.; bituminous material, 1.57 gal.
Average haul, 12.2 miles. Cost per ton mile, $0.0656.
Cost per square yard:

Slags	$0.1156
Bituminous material	.1404
Labor	.0564
Equipment	.1031
Total	$0.4155

The efficiency with which the county engineering staff works may be judged from the following tables, which analyze the man-hours and the equipment-hours (included are the operators) needed for the two types of road surfaces.

Surface Treatment

1,000 sq. yds. used as a unit. Average haul, 9.20 miles.

Supervision	.4351 hours
Foremen	.4704 hours
Unskilled labor	3.8800 hours
Trucks	4.8360 hours
Distributors	1.2120 hours
Rollers	.7125 hours
Sweepers	.4229 hours

Retread

1,000 sq. yds. used as a unit. Average haul, 12.2 miles.

Supervision	6.233 hours
Foremen	3.839 hours
Labor	24.400 hours
Trucks	36.860 hours
Distributors	4.857 hours
Rollers	5.184 hours
Graders	3.569 hours
Sweepers	1.634 hours

With a major share of the general highway improvements completed or well under way, Mr. Schomer during the current year is planning to correct numerous traffic hazards which have been pointed out through a comprehensive traffic survey. Much of this work will entail the re-location and straightening of existing roads. Another portion of the increased safety program will be covered by the erection of new and wider bridges or drastic alterations on older ones. Many of the spans extant in the county are utterly obsolete and unfitted for the heavy and high-speed traffic which the survey has revealed.

Modern machinery, particularly the welding outfit, has made it possible for the engineer's office to show great savings in the bridge division by undertaking larger structures which heretofore have been built by private concerns under contract. Largest county bridge construction job to date is a 60-foot span with steel beams, a steel T-grid type flooring, and an all-welded railing. Abutments were made of stone from the county quarries. Besides this job, the county has made alterations on even larger structures. The open-type welded steel railing is favored wherever possible, as it has been found less expensive to erect under the present set-up and is considered to have more "motorist appeal," the grill enhancing rather than detracting from any scenic views.

Another type of span which is considered particularly adaptable to some soil condtiions is the concrete barrel arch. Such an arch, 18 feet in diameter, was used to good advantage at a point where a railroad embankment paralleled a county road. The arches were used under both tracks and roadway, the construction being made into a single unit through connecting the arches by an open-top culvert. Such construction eliminated high water current hazards which might have been present if separate spans and abutments had been used under the two embankments.

Budget limitations have required that all improvement planning be done with an eye toward conserving existing resources. Consequently, a staunch 110-year-old covered bridge on Mahoning County's northern border is still being used after being reinforced with modern concrete piers. The piers were built to conform with plans for a modern bridge to be built in two or three years and will simplify that construction considerably.

A policy of continuous rather than seasonal bridge maintenance has been founded. Except when extreme weather conditions prohibit, paint crews are kept at work on a schedule which last year saw attention given to all steel spans in the county.

The bridge program this year is being kept to a minimum of construction aimed at reducing the greatest of traffic hazards. More ambitious programs will be undertaken when a larger budget is secured. Mr. Schomer is putting his unexpended balances into a fund for the erection of one large bridge. Such a plan piles economy on top of economy, as it will eliminate expenses of a bond issue which otherwise would be necessary.

Highway Employee's Right to Disability Compensation

An employee of the Louisiana Highway Commission was awarded workmen's compensation for permanent disability under the following circumstances: His duties were to receive and keep account of the equipment and machinery required by the district. In connection with this, lifting and other manual work was required of him. In assisting his fellow workmen to load a Fresno onto a truck, he strained his back and was in bed for several weeks under medical care. He then resumed work solely in keeping track of repair parts. Several weeks later he was discharged.

The Louisiana Court of Appeal (Hennen vs. Commission, 178 La. 654) held that the employe was entitled to compensation for an accident arising out of and in the course of his employment. The medical testimony conflicted irreconcilably as to whether the applicant's disability was due to the lifting of the Fresno or to an infected blood stream. The court said it was very likely plaintiff's system possessed this infection prior to the accident, but the strain obviously aggravated this condition and was a contributing agency in the effecting of plaintiff's disability. The Louisiana courts hold that it is sufficient if the disability be the result of a condition arising from the injury, or that the injury is a contributing cause of the disability. The award was sustained.

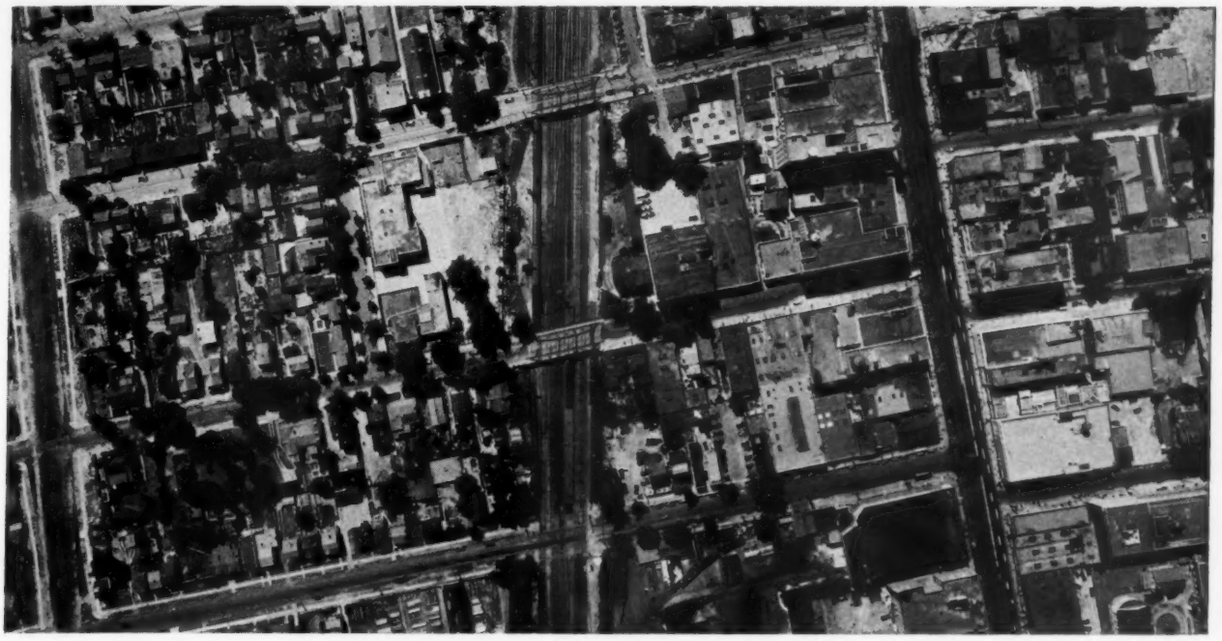
How Minnesota Keeps Up Its Highway Bridges

It is a policy of the Minnesota Highway Department to check all bridges twice a year and to then make all repairs necessary. The check-up crews are composed of two men each. These are men employed the year around by the department and, therefore, the spring and fall inspection does not bring any need for hiring additional help.

Each crew is assigned to specific districts. Tools include push brooms, sidewalk scrapers, a pick axe, chisel pointed bars, wrenches, sledge hammers and paint. The crews minutely cover each bridge, they correct plugged drains and bent railings, replace missing bolts in railings, loose nuts on railing bolts, loose expansion plates and the like. Rusty spots that appear on the steel work are painted. Dirt and sand are removed from bridge floors and truss members and from the bridge seats around roller or rocker bearings. Channels under the bridges are cleaned and all brush and trees under or adjacent to the bridges are cleared away. Excess washing or cutting of banks under the bridges is corrected as well.

If a bridge is in such shape that the two-men crews cannot make repairs, this fact is reported to the bridge division of the department and special bridge crews do the work.

This semi-annual inspection of the 2,500 bridges on Minnesota's trunk highway system is both an economy and safety measure. If a bridge, like anything else, is kept up, its lifetime is doubled or trebled. Moreover, it is obvious that rundown bridges are highly dangerous mediums for carrying transportation.



Aerial photograph for railroad yard extension, Jamaica, Long Island

Aerial Photography in Public Works Engineering

By WILLIAM H. MEYER, JR.

General Manager, New York Division, Fairchild Aerial Surveys, Inc.

AERIAL photography today is both an art and a science. Its artistic products are widely used as illustrations by all classes of publications. To engineers and public works officials its practical uses are most important. By it planning of highways has been simplified, slum clearance aided, and studies of many other proposed public works facilitated. Before building the Triborough Bridge in New York, aerial photographs permitted selecting the property which needed to be condemned. New York City's Department of Sanitation used aerial photographs of the East River, taken before and after the Wards Island sewage treatment plant began operating, to show the disappearance of evidence of pollution in the water.

Assembling the Mosaic

The greatest development of scientific aerial photography, however, is in map making, whereby large numbers of prints of adjacent areas are brought to the same scale and combined to form accurate maps of large areas, equal to ground surveys in almost every respect and, in many cases, at a small fraction of the cost. Its accuracy is so well recognized that it is used by the U. S. Coast and Geodetic Survey, the Dept. of Soil Conservation, by the AAA in computing acreage for crop control. A contour map of the lake formed by Boulder dam was obtained by photographing the water surface at each 10 ft. rise in elevation. Its use in tax mapping is gaining wide recognition.

Mapping from the air is done in three ways—by direct sketching, by oblique photography, and by vertical photography. The first gives preliminary data at low cost; the second gives an excellent visual idea of the country, especially if flat. Vertical photographs are used for making aerial "mosaic" maps, groups of them being assembled and matched together, and either stapled together or mounted on cloth or board, and rephotographed as a single map. The detail of such a map varies with the focal length of the camera lens and the height at which the plane flies. On a suitable scale, such a mosaic can be used as a dependable map in itself, or can be converted into a line map.

For these maps the aerial photographs are usually taken by a single-lens camera with an automatic shutter, which takes successive overlapping pictures of the land flown over. With a new piece of equipment, the "solar navigator" (recently developed by Fairchild), strips 100 miles or more in length can be flown over in almost

perfectly parallel flight lines. The films, for usual commercial purposes, are 7 x 9 or 9 x 9 in., in rolls giving from 100 to 200 exposures. After the series of overlapping photographs has been taken, the films are developed in special developer by a process that may take as long as two hours, and contact prints made.

While work in flight is highly important to successful mapping, just as much care is necessary with the work done on the ground. At the Woodside laboratory of this company intensive studies are constantly being made of all steps necessary for making the finished mosaic map, carefully checked for accuracy. Boards, usually 9 x 12 ft , placed on tables are used for mounting the prints. In order to establish the location of the prints, the board is first marked with "controls" computed to the desired scale, obtained from the most accurate map records of the photographed area that are available. The control points are next selected and identified on the individual prints to be used in the mosaic and a template, or guide pattern, for each print is marked with control points. Due to bumps and air pockets, one precise elevation of the airplane cannot be maintained during the entire survey, and at the same time variations in the terrain present a deviation factor which cannot be avoided. For this reason, while the original contact prints are all of *approximately* the same scale, they may vary slightly from one another. The contact prints are therefore checked for scale from the control plotted on the mosaic board, and a correction factor, called a "ratio," for each contact print is computed. New prints are then made from the negatives, enlarged or reduced to the correct size on the basis of these ratios.

In finding landmarks on the prints and measuring the distances between them, measurements are made to 0.01 of an inch, and the men doing this work must have excellent lighting, uniformly distributed over the table, at a high level of illumination, detail-revealing and lacking in shadows. In addition, the light source itself must be of low intrinsic brightness, in order that glare from photographic prints be reduced to a minimum. Also, the prints must be carefully matched for tone so that each individual print reproduced in the finished map will blend in the composite whole, and the lighting must be of such a nature as to show up any slight differences in tones.

In view of the critical seeing tasks involved, we have used long-tube mercury vapor lamps of the Cooper Hewitt type over these tables for a number of years. Recently we have modernized our lighting installation with the newly designed 50-inch Cooper Hewitt lamps, which operate at 350 watts, producing 22% more light than before. An illumination level of 30 foot-candles is supplied by these units, which are mounted about five feet above the tables. As this type of lamp is inherently low in unit brightness, it furnishes practically shadowless and glareless light for the work.

The frame containing the completed mosaic is finally removed to another section of the plant, where it is placed in a vertical position before a large copying camera, which photographs the completed mosaic. Illumination for the copying camera also is furnished by a 50-inch Cooper Hewitt lamp, mounted vertically beside the machine; the concentrated light from an ordinary light source is productive of shadow lines along the overlapping edges of the individual prints, which lines must not appear in the finished print.

In the enlarging department, incandescent lamps were formerly used as a light source for making the rescaled prints and oblique angle views, but recently

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 55-57

a new type of rectangular mercury vapor tube has been substituted in the cameras, reducing exposure time and resulting in considerable saving.

The rapid growth of photographic map making has been stimulated by the development of many special instruments and plotting machines, among which are a multiple-lens camera and a multiple-lens stereoscopic plotting machine. Improvements have been made almost yearly on the mapping cameras. While single-lens aerial cameras are still used for most aerial mapping, for certain types of work, cameras with more than one lens would be desirable. Recently, Fairchild delivered to the U. S. Coast and Geodetic Survey a giant camera with nine lenses mounted in a single unit.

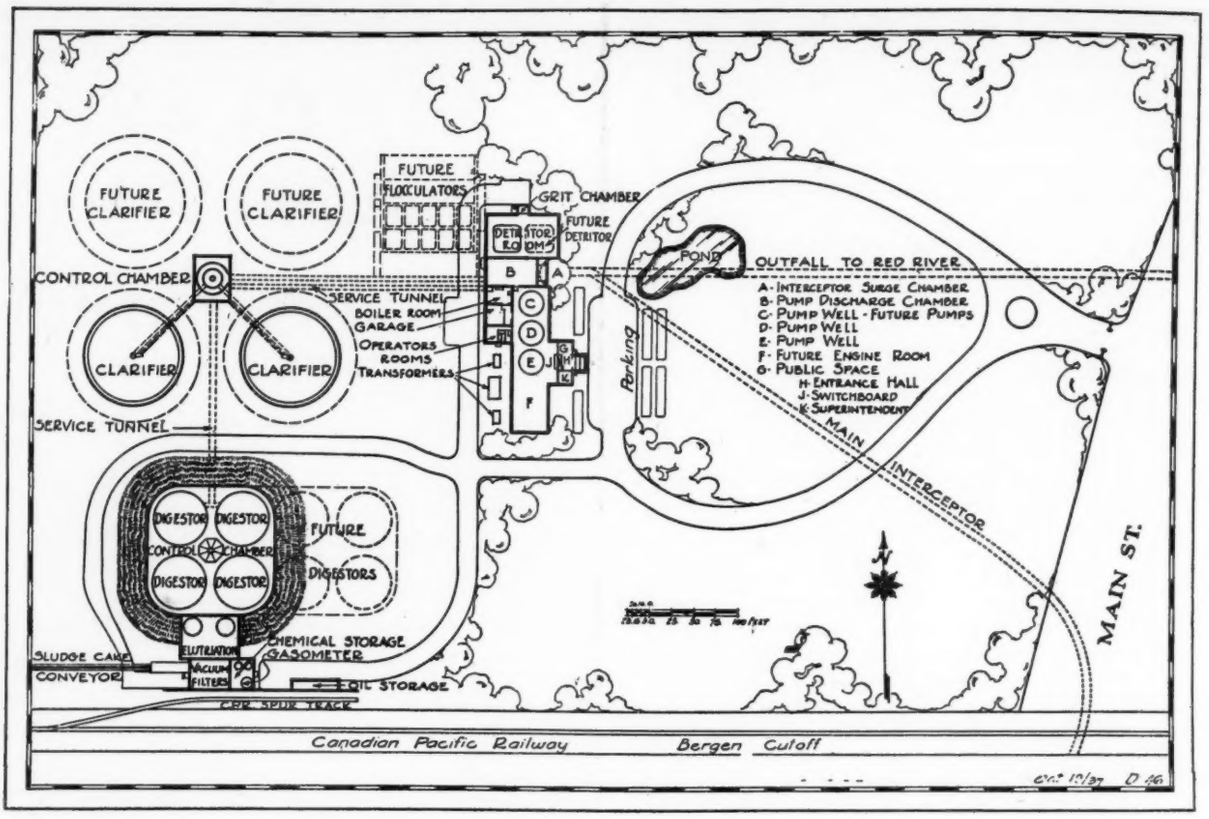
In the early days of mapping operations, existing aircraft were not readily adaptable to photographic use. Today, however, photographic airplanes have been developed which have instrument boards equipped with a sensitive altimeter, directional gyro, artificial horizon and other instruments to assist the pilot flying a straight, level course.

Photogrammetry is the art of preparing precise *contour* maps by aerial methods. When two overlapping aerial photographs having a common area are viewed through a stereoscope, the common area appears in relief. A new stereoscopic plotting machine called the "Stereoplanigraph" is now used in plotting these contour maps. The exact angle and elevation of each picture is reproduced at the small scale of the stereoscopic model. Then, when the picture is viewed stereoscopically, an index or reference mark is provided, which is so mechanically articulated by the machine that it appears to move only in a single horizontal plane. Thus, the index mark appears to float in the air if it is out over a canyon, and it appears to bury itself in the plastic ground if it is deeper than the ground surface. The operator can tell exactly when the index mark is in contact with the surface of the ground. By operation of two hand wheels, he causes the index mark to trace off the surface of the plastic image, forming an accurate contour map which the machine draws on a piece of paper.

With new improvements in equipment and procedure, the accuracy of photographic map making has become increasingly greater. In the past five years alone, so many improvements have been effected in this industry that it is difficult even for those of us directly engaged in it to keep abreast of the latest developments. Of those described herein, the mercury lamp lighting installation should prove valuable not only in photographic map making, but to those engaged in engineering drafting of all kinds.

Safety in Clearing Work

Clearing of trees and brush at the site of large construction projects or along highways results in many injuries. By planning the work, carefully selecting the men, and instructing and supervising their activities few injuries will occur. Men must be taught the safe way to sharpen, carry and use sharp tools. Before felling trees, underbrush and vines should be removed. Dead trees should be taken out before cutting live ones. Eye injuries and scratches can be prevented through care in handling material. When trees are about to fall men should be warned by loud signals to stand clear. In this class of work it is desirable to have small groups under the direction of alert and experienced men acting as straw bosses. Short talks on safety before starting work in the morning will do much to instill an interest in and understanding of safety.—*National Safety Council.*



General layout of sewage treatment plant of Greater Winnipeg

Sewage Treatment for Greater Winnipeg

THE Greater Winnipeg Sanitary District was created by an act of the Province of Manitoba in March 1935, and an agreement entered into for the construction of sewage disposal works by which the Dominion would pay 40% of the cost, the Province 20%, and the municipalities 40% and also the cost of land, administration, etc. The district included the city of Winnipeg and such contiguous municipalities as might wish to join; those so joining including the city of St. Boniface and the rural municipalities of West Kildonan, East Kildonan and St. Vital; giving a total present tributary population of 260,000.

The first contract, for a part of the main intercepting sewer, was awarded on August 21, 1935 and operations begun 6 days later (for work relief); and 55 more contracts awarded during the next two years.

Interceptors bring the sewage from the five municipalities to a treatment plant at the north boundary of West Kildonan, sixteen pumping stations being necessary for raising sewage from low areas. The interceptors total 7½ miles and vary from 3½ to 7½ ft. diameter, to deliver 16 mgd to the plant, this being 2.75 times the dry-weather flow estimated for an ultimate 585,000 population. They are of concrete; while the secondary sewers include brick, concrete, vitrified clay, cast iron and wood stave.

All sewage passes through comminutors before entering the interceptor. The plant includes sedimentation, separate sludge digestion, elutriation and vacuum filtration. The buildings include a main building housing surge well, pump wells, discharge chamber, detritors, laboratory and office, wash rooms etc.; clarifier control building; digester control building; elutriation building; chemical storage building; and vacuum filter building.

The sewage flows from the interceptor into a surge chamber 52 ft. below ground level, whence it is lifted to a discharge chamber at ground level by pumps with total capacity of 87.5 gpd. From here it can pass directly to outfall; or through detritors to outfall; or through detritors to clarifiers; or through detritors, one clarifier, flocculators and the second clarifier; or through detritors, flocculators and both clarifiers in parallel; or bypass detritors and flow direct to the clarifiers. There are two detritors, only one at present mechanically operated, using a Dorr type grit washer 30 ft. square. The flocculors have not yet been built.

There are two 115 ft. circular settling tanks equipped with Dorr "Sifeed" clarifiers, each discharging effluent into an annular basin surrounding it and thence to the outfall. These basins remove about 55% of the suspended organic matter. The clarifier control building also contains sludge pumps, effluent pumps to elutriation tanks, sludge sampling tables and control gates. Room is provided for two more clarifiers.

The sludge is pumped to four digestion tanks, each 60 ft. diameter by 25 ft. side depth giving a theoretical detention period of 50 days, with fixed steel covers and heating coils; the covers and 8 ft. of the sides being insulated and the sides also banked with earth. Gas is

collected and is used to heat the buildings and tanks but not for power, although gas engines can easily be installed if it should seem advisable in the future. These tanks can be operated all as primaries or two as primaries and two secondaries.

Digested sludge flows to two elutriation tanks 22 ft. diameter by 10 ft. side depth, each containing a Dorr thickener, with mixing equipment and sludge pumps. Counter current elutriation is employed, using water from the outfall sewer. The building also contains a chlorine contact chamber and space for two future thickeners.

The elutriated sludge is taken to mixing tanks in the vacuum filter building, where ferric chloride is added, and is dewatered on two 6 x 8 ft. Conkey vacuum filters, the sludge from which falls onto a conveyor belt, and drops from that into a car in the basement, which is run on a trestle and dumped.

The chemical storage building, adjacent to the vacuum filter building, contains rubber-lined ferric chloride tanks, lime storage space, gas meters and flame traps, digester-heating boilers, waste-gas burners, and a balancing gasometer 10 ft. diameter and 10 ft. high.

The treatment plant cost approximately $1,110,000 and the collection system $2,215,000. The board of engineers in charge of the work consisted of the municipal engineers of the municipalities comprising the district and others representing the Dominion and Provincial governments, with W. S. Lea as consulting engineer. W. M. Scott, chairman of the Water District Commission, was appointed commissioner of the Sanitary District on Sept. 1, 1937.

Excavating Large Ditches and Channels With Dynamite

Just how large a ditch or channel can be blasted with dynamite is not exactly known. Such use of dynamite has proved of value in flood control and for various other purposes where speed in doing the work was a factor or it was not practicable to move machinery to the sites because of transportation difficulties. That explosives experts are now able to blast larger and larger channels is a fact of which many are unaware. According to the Agricultural Extension Section of E. I. du Pont de Nemours & Co., a recent piece of work was done in Pennsylvania, where a single line of holes was used to make a channel 20 feet deep and 60 feet wide at the top with a 20-foot bottom width. The amount of dynamite per hole was based on one pound per cubic yard. Material moved was a wet clay type of soil. In South America, a channel was made 80 feet to 120 feet wide and from 6 feet to 15 feet deep in a clay type of soil, which was extremely wet. Due to the great width desired, it was necessary to use an additional quantity of dynamite to throw clear this material, so the basis of loading was 1¾ pounds per cubic yard. Where the desired size of channel can be obtained with a single line of holes, the maximum can be expected from the dynamite. Such loading may start with a half pound of ditching dynamite per hole, and go to as much as 150 pounds per hole. The general practice is to column load half pound sticks up to five or six sticks per hole. Loads larger than that are usually bundle or large cartridge loads, exploded in holes six to eight inches in diameter, which are made by means of a post hole digger. On some work cartridges as large as five inches in diameter and 24 inches long were used.—*Journal of Franklin Institute.*

Sample of "spot" treatment along rural highways

Dustlaying and Surface Binding With Calcium Chloride

DESPITE the mileage of surfaced roads, there are still many thousand miles of rural highway that, with the approach of dry summer weather, become a nuisance and a danger from dust. The following information regarding the use of calcium chloride for laying dust and for surface binding is based on a recent publication by a manufacturer of calcium chloride.

For general use as a surface binder and dustlayer it is simply necessary to distribute the small flakes of calcium chloride uniformly over the surface to be treated, at a prescribed rate per square yard. Since best results are obtained from an even distribution of a material, a suitable spreading equipment should be used when treating streets and highways. For highway work, trailer-type truck-drawn spreaders are usually employed. Small areas may be treated by means of a hand operated spreader. It is also possible to distribute small quantities by means of shovels, rakes and brooms if particular care is taken to see that the material is carefully spread.

For best results, calcium chloride should be applied in two or more light applications rather than in a single heavy one. The interval between these applications will depend on the variance of soil and weather conditions.

Calcium chloride can be applied at any time, it being unnecessary to shut off roads or drives either during or after application. The amount of moisture in the air or in the surface being treated governs the time required for the flakes to dissolve and soak into the surface. Do not apply calcium chloride if there is a possibility of rain within two hours after application, as such a rain would wash away some of the chemical. Rain that occurs after the flakes are dissolved will have no effect. On loose, uncompacted gravel, better results are usually obtained if applications are made shortly after a rain, when the road material is more compact.

In applying to roads, walks, drives or sidewalks, it is necessary to treat only within about a foot of either margin, as the material, on dissolving, will spread sufficiently to cover this extra area.

Calcium chloride should not be applied to a surface which has previously been treated with oil, tar or asphalt. Special preparation of the surface is necessary in such cases. Directions for use under such conditions is available from any of the manufacturers of the chemical.

During the process of applying, and until the calcium chloride is dissolved, the workmen should wear rubbers or rubber soled shoes. While calcium chloride is not aggressive and will not attack rubber, leather, clothing or other materials, it has the property of absorbing moisture from the air or from any other materials with which it may come in contact. Therefore either the flakes, or a concentrated solution, will draw moisture from the leather, leaving it hard, just as when wet leather is dried too quickly by means of heat. After the calcium chloride has been absorbed into the surface of the road, this possibility is past.

About two pounds per square yard per season are required for dustlaying on most roads, but the required amount will vary silghtly in different sections of the country and under different climatic conditions. The quantity per application also varies with the type of surface upon which it is applied. First applications generally should be three-quarters of a pound to one and one-quarter pounds per square yard. When the first

Spreading calcium chloride in Morristown National Park

signs of dryness appear, a second application should be made of one-half to one pound per square yard of the area being treated.

Generally speaking, the total quantity of calcium chloride required and the rate of application vary with the clay or earth content of the surface. On roads having a relatively high clay content, applications can be reduced to as low as ½ lb. per square yard per application. On sandy or stone surfaces, the initial application can be as high as one and one-half pounds per square yard.

The following table shows the number of running feet of roads of varying widths which can be covered with one 100-lb. bag of flake calcium chloride when applied at the rates shown:

Quantity 77-80% Flake Calcium Chloride	Rate of Application per Square Yard	Covering Capacity in Linear Feet per 100 lb. Bag						
		8 Foot Wide	10 Foot Wide	12 Foot Wide	14 Foot Wide	16 Foot Wide	18 Foot Wide	20 Foot Wide
100 lbs.	½ lb.	225	180	150	128⁸/₁₀	112½	100	90
"	¾ "	150	120	100	85⁷/₁₀	75	66⅔	60
"	1 "	112½	90	75	64³/₁₀	56¼	50	45
"	1¼ lbs.	90	72	60	51⁴/₁₀	45	40	36
"	1½ "	75	60	50	42⁹/₁₀	37½	33⅓	30

(Courtesy Solvay Sales Corp.)

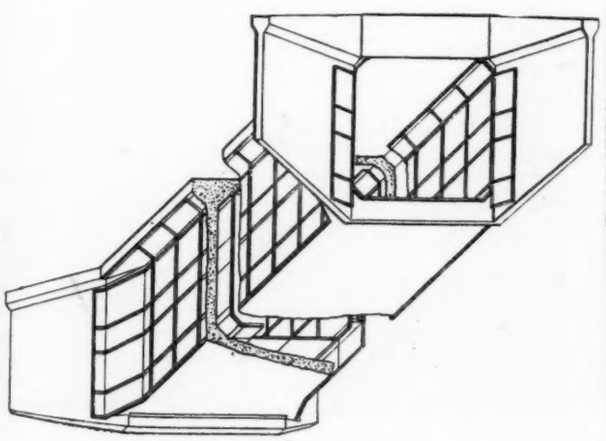
"Spot" treatment for dustlaying is a valuable builder of good will where it is not possible to treat all the roads. This can be done in front of residences along the roads, at schools, built up sections and other important places. The cost is small for such short lengths of treatment, but in some places the work is done on a cooperative basis with the farmer or industry benefited paying a part of the cost.

Steel Sectional Forms for Culverts

The Main Roads Commission of Queensland last year began replacing with reinforced concrete culverts many of the old and unsafe timber structures in Brisbane City and Tingalpa Shire. As there were a number of these, it was thought that standard steel forms might be used instead of timber lagging with a reduction of cost.

These forms are made in flanged units 3 ft. long and 2 ft. and 3 ft. high, with fillet sections (used at the junctions of sides with both top and bottom) 3 ft. and 2 ft. long by 1 ft. rise. By bolting these together, forms can be made for culverts with lengths of any multiple of 3 ft., and any height and width from 4 ft. up by one-foot increments. For the ends of the outer wall forms, sections are provided 2 ft. or 3 ft. high and 6 ft. long with skew ends for forming the wings. Standard hole spacing and accurate fabricating on jigs enables the entire section to be bolted together in any orthogonal position. Pipe spacers on tie bolts main accurate wall thickness and rigidity of forms.

Use of the forms last year indicated considerable saving over the use of timber.



Steel form for culverts

Widening Roadway Over Stone Arch

By CHARLES OGAN
County Engineer, Huron County, Ohio

OBTAINING a clear roadway width of 25 feet over an arch bridge only 24 ft. wide with 19 ft. clear roadway was accomplished last year in Norwalk Township, Ohio, without lengthening the barrel of the arch. The bridge is of the filled-spandrel arch type, built some 70 to 75 years ago of sandstone which was quarried a short distance from the bridge.

The arch is a semicircle of 7 ft. radius with the spring line 5 ft. above the flow line of the stream, with spandrel walls 60 ft. long and 20 ft. above the flow line. The barrel of the arch was approximately 24 ft. long over all but the clear roadway was only 19 ft., made up of 16 ft. of concrete pavement, with a guard of wire mesh on cedar posts in each 18 in. berm between pavement and header walls.

The spandrel walls were removed to a level about 30 in. below the surface of the pavement, the stones so removed being used to build wing walls at an angle of 45° at each end of the arch to retain the additional fill to be placed in widening the road. On top of the lowered spandrel walls were placed reinforced concrete cantilever beams extending 2 ft. 3 in. beyond the original spandrel walls and extending 2 ft. under the pavement to give it extra weight and sufficient anchorage to support a standard state highway concrete railing. Each slab extended 6 in. horizontally beyond the wall, then at a 45° angle for 2 ft., ending with a 6 in. vertical face, bringing the top of the slab level with the concrete pavement. When completed, the appearance from above was that of a state highway standard structure with a clear roadway of 25 ft.

The work required removing 20 cu. yd. of stone masonry and relaying it for wing walls, 46 cu. yd. of hand excavation, 72.5 cu. yd. of 1:5½ reinforced concrete, 6 cu. yd. of 1:6½ plain concrete, 3,126 lb. of reinforcing steel for slabs and curbs, 128 lin. ft. of concrete railing, 64 lin. ft. of standard guard rail, and 800 cu. yd. of borrow excavation for widening the roadway. This cost approximately $2,392.

Completed construction for widening highway bridge

In addition it was necessary to do considerable work in the way of concrete underpinning and veneering to protect the foundations, which were in rather serious condition. This brought the total cost up to $2,912.68.

The improvement was planned and designed by the writer and the work was carried out by the county maintenance forces under the direct supervision of V. A. Richards, superintendent.

Care as to Unexploded Dynamite Charges

In an action against a road construction company for the death of a jackhammer operator killed by the explosion of an unexploded charge of dynamite while he was drilling a hole, it appeared that charges in groups of 15 to 40 were connected with the blasting machine and exploded simultaneously. Due to crossing of the wires or other causes there could be times when some of the charges did not explode.

There was evidence that the company's foreman had reason to believe there was an unexploded charge in the proximity of the accident, had searched for it and warned the operator who had preceded the deceased that day, but failed to warn the deceased.

On appeal from judgment for plaintiff in the Federal District Court for western Oklahoma, the Tenth Circuit Court of Appeals (L. E. Whitham Const. Co. v. Remer, 93 F. [2d] 736) reversed the judgment and granted a new trial for errors in instructions to the jury. The court stated the law of the case as follows:

The master is under a nondelegatable duty to warn and instruct his servant as to defects and dangers of which he knows or ought in the exercise of reasonable care and diligence to know, and of which the servant has no knowledge. So that the trial court properly denied the defendant's motion for a directed verdict.

But although the law cast upon the construction company the duty of exercising reasonable care in searching for unexploded charges of dynamite and protecting its employees against the dangers thereof, it did not cast upon the company the absolute duty of locating such charges.

The court adopted the language of the United States Supreme Court in Mather v. Rillston, 156 U. S. 391, 398: "Indeed, we think it may be laid down as a legal principle that in all occupations which are attended with great and unusual danger there must be used all appliances readily attainable known to science for the prevention of accidents, and that the neglect to provide with readily attainable appliances will be regarded as proof of culpable negligence."

An instruction of the trial court which went further than this in stating the obligation of the construction company and in effect made the construction company an insurer of its employees was held to be inaccurate and reversibly prejudicial.

Cost of Broken Fire Hydrants

A Massachusetts city reports that in 1937 thirteen of its fire hydrants were broken by skidding or carelessly driven automobiles. (Total number of hydrants in use, 1904). The cost of repairing these was $676.58, plus the loss of water, which sometimes is quite an item. This gives an average of $52, plus lost water, per hydrant.

Can any one give us the figures for cost of restoring one of the several makes of hydrants that have a breakable joint at the ground surface—Mueller-Columbian, "Safetop," "Protectop," etc.?

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

Algae growths in Lake Winnebago caused serious taste and odor troubles in the water supplies of Oshkosh and Neenah, Wis. Experimenting with carbon, ozone, aeration, etc., led to the conclusion that "activated carbon was the most practicable and positive method of removing tastes and odors" from this water, used either as powder or granular in beds. Comparison showed that 120 lb. of granular carbon operated to exhaustion had the capacity of 176 lb. of powder; but the latter was cheaper, and the installation cost was nominal while granular filters are more costly to build and maintain. But both were used at Oshkosh, due to the extreme fluctuations in the quality of the water, the powdered carbon to do practically all the work, the granular filters, in series with sand filters, to insure results during extreme conditions. Neenah in 1937 built a plant for filtration, softening, and taste and odor removal for 2 mgd, providing 5 minutes flash mixing, 60 min. flocculation, 4¾ hr. in coagulating settling basins, 30 min. in recarbonation basins, and sand filters, followed by upward-flow granular carbon filters. The plants have not been operated long enough to determine the life of granulated carbon, but the experimental studies conclusively demonstrated that "the life would be very short unless the real work was largely done by powdered carbon."[A77]

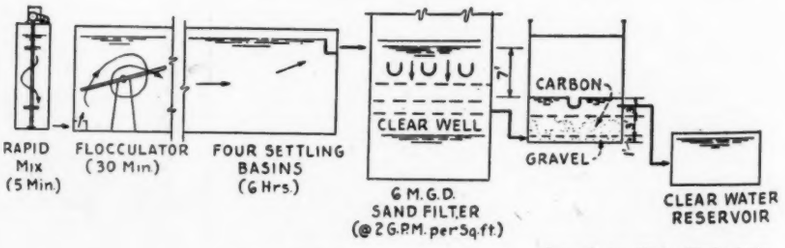
Activated carbon requires careful handling because of its "dusty, black, penetrating dirtiness." In emptying the bags into the feed machine hopper, have the carbon fall as small a distance as possible; have a hood over the hopper with opening just large enough to let the bag through; an air suction in the hood will help. All joints between hood and machine and in machine should be dust-tight, also point where carbon drops from feeding mechanism to mixing bowl—a water ejector in the feed line creating a suction helps. Some feeders are entirely enclosed in metal cases but the best of these are none too sucessful. The best solution is complete segregation of carbon machines in tight rooms away from the operating floor. The pipe carrying the suspension to point of application should be short, with provision for cleaning out settled carbon, on continuous down grade with ample flow of water. Oshkosh has the most dust-free installation that the author had seen. A gravimetric feeder is filled from the floor above, where the top of the hopper is enclosed in a cabinet, and a current of air into the cabinet is induced by a water ejector, which draws the dust through a sheet metal pipe and discharges it into one of the basins. The carbon from the feeder is discharged into the mixing bowl of the machine under water.[A78]

Water softening plants differ in design distinctly from filtration plants that do not include softening. Chemicals cost about 1c per 1,000 gal. for each 100 ppm of reduced hardness. For aeration, patented devices are no more efficient than spray nozzles, step aerators, etc., but are much more sightly, occupy less space and cause less splash. Devices for handling chemicals are of major importance. Dry feeders have almost entirely superseded solution feed. At large plants, pneumatic handling of chemicals is desirable. Mechanical mixing devices are preferable to baffles. Prolonged mixing—20 to 40 min. is necessary. For clarifiers, either a rectangular basin with longitudinal flow or a circular basin with radial flow is satisfactory; a square basin with transverse flow is not. Sludge disposal is a chief difficulty; methods used are discharge into a stream, into lagoons (selling sludge to farmers), and incinerating to calcium oxide for re-use. "A satisfactory means of disposing of lime sludge must be found within the near future, or a lime-soda type of water softening plant will often not even be considered for this reason alone." For recarbonation, a coke furnace is common in large plants only, oil or gas fuel in small ones; flue gas from coal fire may contain phenols which cause tastes if water is chlorinated. The filter sand incrusts and provision for removing and replacing it is desirable—a high-pressure water line for a water ejector, a sand washer and gravel grader, storage bins for sand and gravel, etc. Pressure filters are very undesirable in lime softening plants.

Zeolite softening has distinct advantages in many cases. Should be followed by aeration to release CO_2 or other method of pH adjustment where it is low. Pressure units have advantages, especially for small plants. Gravity units are similar to sand filters, but are deeper—3 ft. for down-flow, 4 to 6 ft. for up-flow. It is desirable to purchase salt in bulk—at least a month's supply, and dump it directly into a salt basin.[K4]

Motors for pumps in water works plants should be selected only after considering: 1—Type of motor (squirrel cage or synchronous, former preferred at 3600 and 1800 rpm). 2—Voltage (depends on plant conditions and power company system). 3—Starting current limitation as imposed by power company. 4—Control (manual or magnetic, open or enclosed, reduced or full voltage) and interrupting capacity required for oil circuit breaker.[A73]

Protococcus in tap water at Kilmarnock (Scotland) was found to be due to chlorine. The supply is from a storage reservoir which in turn is fed by a collecting reservoir. The effluent of the latter was chlorinated because of B. Coli. After chlorination the water flowed through 2 miles of pipe to the storage reservoir and stayed in this 60 days. The effluent from the reservoir is filtered, but the filter effluent, in April following the installation of chlorination, became cloudy and green, and the minute protococcus was found to be the cause. Experiments proved conclusively that the chlorination had a decided connection with the abnormal growth of this organism. Copper sulphate was useless as a preventive. The location of the chlorinating plant was changed to the effluent of the storage reservoir and no further trouble experienced.[D22]



Journal, Am. Water Works Ass'n.

Flow design, Oshkosh filter plant

The large barrel of the Darling Fire Hydrant assures an abundance of water at all times. There are five other important advantages.

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DARLING
GATE VALVES AND FIRE HYDRANTS

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 55-57

Elevated tank operation at Fresno, Calif., utilizes a combination altitude and reducing valve, acting as the latter when the top half of the water is flowing out, and as an open valve for the lower half and for inflow. This is effected by using an altitude pilot valve, actuated by tank pressure, which closes the valve when the tank is full; a reducing pilot, actuated by main pressure, to control the outflow of the upper half of the tank; and a double-acting pilot, actuated by tank pressure, to open the valve when the tank is half empty. The reducing pilot allows pumping to begin before the upper half of the tank is exhausted, thus preventing dumping of tank at main pressures above the equivalent of a half-full tank. The double-acting pilot opens the valve at the beginning of peak demand and during the following refill period.[A60]

Alkali bentonites in water form in general highly colloidal systems of negatively charged particles which react with mono-, di-, and trivalent cations to form adsorptive flocs in accordance with well established physical laws. Lime softening of a water containing carbonate hardness presents a particularly favorable situation for use of bentonite for clarification. Certain protective colloids, such as tannins from leaf molds, inhibit to some extent the precipitation of the bentonite sol. The speeds of the reactions involved are functions of the water temperature.[A68]

Scale in pipes is removed by an acid preparation called "hydro-artgel," originally designed for cleaning boiler tubes. The pipe to be cleaned is shut off from the system, connections made at the two ends and the pipe emptied and filled with a 25:75 solution, which is pumped back and forth from a tank at one end to another tank at the other; after 4 to 6 hours of this, the liquid is pumped into a sewer, the remaining acid nuetralized with sodium carbonate, and the line is thoroughly flushed out with fresh water. Complete removal of tuberculation without corrosion of pipe walls or injury to bituminous lining is claimed. Cannot be used in cement pipe or lining. For pipe more than 6″ diameter the cost is greater than mechanical cleaning.[Y3]

Settling basins in the new Norwalk, Conn., filter plant, in duplicate with total detention period of 4 hrs., are divided by low over baffles into two sections, the first, which comprises the first third of the basin, being underdrained by 6″ vitrified tile lines spaced 3′ centers, each line consisting of 6″ x 4″ tees set in the floor with the 4″ hub flush with its surface and provided with tile plugs containing 1″ orifices. The bulk of the sludge is deposited in this part of the basin and can be withdrawn through these orifices without unwatering the basins. Pressure water lines with hose valves are provided for thorough cleaning of the basins.[F37]

Steel pipe, badly pitted, was rejuvenated in the Los Angeles, Calif., water system by encasing in reinforced concrete. The pipe was 16″, 0.134″ thick, under 70 lb. pressure. It was uncovered and cleaned and a machine fitted over it consisting of a 3 hp. gas engine which operates a rotating steel drum surrounding and concentric with the pipe. Fastened inside the drum are steel lugs extending as spirally curved cantilevers around the pipe; while on top of the housing is a hopper which feeds concrete into the annular space between the pipe and the drum. As the drum revolves, the spiral lugs revolve with it and press the fresh concrete against that already compacted, this pressure forcing the entire machine ahead as the concrete envelope is built up. A seal coat is sprayed over the concrete as soon as it is uncovered. Crimped wire, 14 gauge in 3″ lengths, is fed in with the concrete and the lugs distribute it quite uniformly in a generally circumferential direction, giving more than one strand to each sectional sq. in. of jacket. After 12 months, no leakage is reported.[E32]

Bibliography of Waterworks Literature
The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

A *Journal, American Water Works Assn.*
April

71. The One-Man Town. By John Gough. Pp. 449-454.
72. Fire Protection for Small Towns. By R. C. Dennett. Pp. 455-458.
73. Factors in the Selection of Motors for Waterworks Pumps. By H. A. Bartling. Pp. 459-465.
74. The Ethics of Contracts Guaranteeing Well Capacity. By G. Arnold. Pp. 466-471.
75. Relation of Water Works to Automatic Fire Protection. By W. M. Jones. Pp. 472-476.
76. Moving the Springfield Water Works. By S. T. Anderson and C. H. Spaulding. Pp. 477-485.
77. Treatment of Lake Winnebago Water. By L. R. Howson. Pp. 486-498.
78. Handling and Feeding Activated Carbon. By J. C. Zufelt. Pp. 499-503.
79. *c.* Problems Encountered in Laying Mains. By L. W. Anderson. Pp. 504-508.
80. Experiences with Water Meters. (In Holland.) By A. J. Gurck. Pp. 509-534.
81. Standardization of Water Meters: Discussion of the Dutch Specifications. By R. P. Van Royen. Pp. 535-538.
82. Discussion of Meter Practice in Holland. Pp. 539-542.
83. Water Problems Encountered in the Mining of Sulphur. By H. S. Burns and H. A. Smith. Pp. 543-550.
84. *t.* Removal of Silica from Water for Boiler Feed Purposes. By M. C. Schwartz. Pp. 551-570.
85. *t.* Intercrystalline Cracking in Boiler Steel. By W. C. Schroeder, A. A. Berk and C. H. Fellows. Pp. 571-586.

B *Journal, New England Water Works Assn.*
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12. Preparing and Packaging Liquid Chlorine and Allied Products for Water Plants. By L. L. Hedgepeth. Pp. 1-29.
13. Relining an Elevated Storage Reservoir with Gunite. By R. W. Esty. Pp. 30-57.
14. Submerged River Crossing at Augusta, Me. By S. S. Anthony. Pp. 58-66.
15. Collecting Water Bills. By C. W. Easter. Pp. 67-69.
16. Rate Structures. By T. L. Bristol. Pp. 70-77.
17. Dual System of Water Mains. By D. M. Sullivan. Pp. 78-80.
18. Hydrant Connections and the Control of Dual Mains. By A. F. Ballou. Pp. 81-84.
19. Painting Fire Hydrants to Indicate Capacity. By J. W. Randlette. Pp. 85-89.
20. Payment by the State for Relocation of Water Mains Necessitated by State Highway Projects. By E. A. Merrithew. Pp. 90-92.
21. Steel Pipe for Water Mains. By E. H. Thwaits. Pp. 93-106.
22. Measurement of Sand Expansion. By H. J. Krum and E. M. Jones. Pp. 107-115.
23. Water Works Funds for Water Works Purposes. By L. G. Carlton. Pp. 124-125.
24. Regeneration with Sea Water. (Zeolite Softening at Fernandina.) P. 560.

D *The Surveyor*
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20. *p.* Deep Well Water Supplies. By J. H. Thompson. Pp. 571-572.
21. Sittingbourne and Milton Water Supply. Pp. 573-574.
22. *p.* Examination of the Waters of North Craig Reservoir, Ayrshire. By W. Dunbar. P. 577.

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23. Materials Available For, and Jointing of, Water Mains. P. 605.

E *Engineering News-Record*
May 12

30. Expansion Joints in Concrete Tanks. By H. D. Dewell. Pp. 687-688.

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31. *c.* Novel Earth Handling at Quabbin Dam. By F. W. Gow. Pp. 709-712.
32. Rejuvenating Old Pipe (with concrete). Pp. 716-717.

F *Water Works Engineering*
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36. New Supply for Fort Myers, Fla. By A. P. Black and H. C. Robert. Pp. 594-598.

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37. Filter Plant of Unusual Design. By G. H. Buck. Pp. 658-662.

G *Water Works and Sewerage*
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20. Remote Control Operation of Pressure-Equalizing Stations at Oklahoma City. By A. E. Watjen. Pp. 535-538.
21. Remote Control of Surface Tank Booster Pump Pressure-Regulating Stations (Oklahoma City). By M. B. Cunningham and F. Herrmann. Pp. 539-542.

J *American City*
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13. *p.* Bronze Welding of Cast Iron Pipe. By J. T. Mackenzie. Pp. 67, 69-71.
14. *p.* Use of Asphalt as Protection for Reservoirs and Dams. By J. E. Buchanan. Pp. 73, 75.

K *Proceedings, American Soc. of Civil Engineers*
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4. Water Softening Plant Design. By W. H. Knox. Pp. 875-885.

L *Civil Engineering*
May

1. Treatment of Florida's Artesian and Surface Water Supplies. By M. Pirnie. Pp. 339-342.

M *Canadian Engineer*
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8. *p.* Greater Winnipeg's Water Supply. By W. M. Scott. Pp. 18, 20, 22, 24.

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9. *p.* Greater Winnipeg's Water Supply. By W. M. Scott. Pp. 16, 18.

P *Public Works*
May

24. St. Augustine Completes New Softening Plant. By A. P. Black and C. H. Starling. Pp. 15-18.
25. Service Continued While Pumping Plant Is Moved and Softening Plant Installed. By W. J. Lapworth. Pp. 23, 24, 26.
26. *n.* Certificates of Competency for Waterworks Superintendents. P. 40.

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

The Digestion Tank

Black sulfur dye waste in sewage was treated experimentally by the activated sludge process by the Textile Foundation. Using 9-hour aeration periods and 3.86 cu. ft. of air per gallon of mixed dye waste and sewage containing 500 to 3,500 ppm suspended solids, it was possible, with proper control, to obtain a sparkling clear effluent having a B.O.D. of less than 15 ppm. As high as 3% of dye waste, undiluted with wash water, was treated successfully. It was, however, considered most important that the dye wastes and rinse waters be mixed in equalizing tanks before discharging into the city sewers in proportion to the sewage flow.[C47]

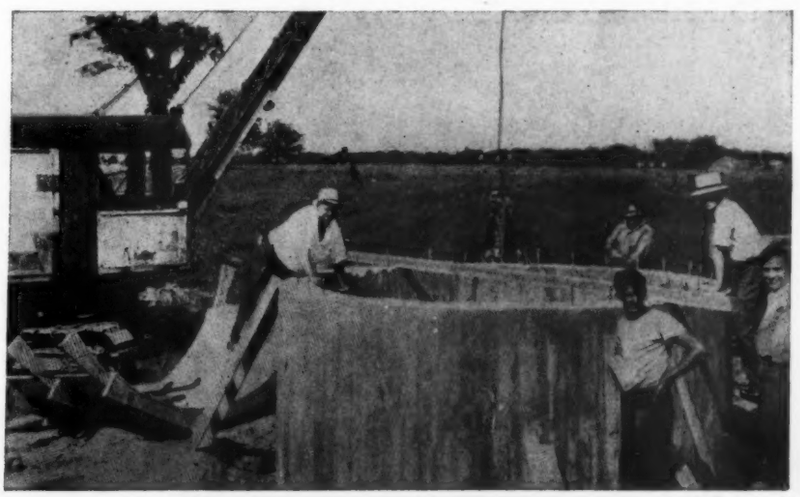
Distillery wastes may be disposed of as slop by spreading on the ground for fertilizing, by anaerobic digestion, or by feeding the hogs and cattle. Or coarse solids can be recovered for feed by discharging thin slop into streams, using it as liquid feed, anaerobic digestion, aerobic stabilization, spreading on land, or by evaporation to syrup, mixing with solid feed and drying. The last is the most interesting to large distilleries, but an efficient plant for such costs $750,000 to $1,000,000; yields 16.5 lb. of feed per bushel of grain used, which sells for $20 to $30 a ton. There are two processes—the standard and a new one by the Hiram Walker Co. In the latter, the wastes are screened through cloth, the screenings pressed, the liquid centrifuged and evaporated to 45-50% solids, and all products mixed and dried to 12% moisture.[H43]

Sewage dilution in Mersey estuary, above Liverpool bay (England) with consequent deposits, was considered by some responsible for increasing the difculty of dredging the ship channel therein. A thorough investigation by the Dept. of Scientific & Industrial Research, covering 4 years and costing $130,000, led to the conclusion that "the crude sewage discharged into the estuary of the river Mersey has no appreciable effect on the amount and hardness of the deposits in the estuary." The concentration of sewage in the greater part of the estuary water does not exceed 1%. Filling of the channel is probably due to mud carried in from the bay by flood tides.[D37]

Unstable ground affected design as well as construction methods of the Ley Creek (Syracuse, N. Y.) trunk sewer and treatment plant. For 1300 ft. from the outlet end of the sewer the soil is muck from the surface to 4 ft. below the invert and the ground water table is above the top of the 48″ sewer. The plant is located 1.3 miles from the lake, discharging into a creek near by, since at that point the invert is already 1.5 ft. below the lowest lake level and to carry it further and deeper would involve serious ground water trouble, and difficulty in securing foundations for both sewer and plant. Where the sewer was laid in muck, this was replaced with gravel under the sewer. At the plant, the ground water was 11 ft. above lake level and nearly as much above the near by creek. To lower it during construction, a concrete caisson 10′ diameter was sunk 40 ft. and pumped at 1200 to 1500 gpm, which lowered the ground water 13 ft., which was lower than the foundations of all but the pumping station, for which well points lowered it an additional 6 ft. This pumping continued without interruption for 15 mos. The caisson will be retained and drains around the principal structure will discharge into it; the caisson in turn discharging into the outlet sewer. The foundations of all the structures are carried to coarse, black sand below the quicksand. In building the plant, concrete was conveyed to it from a central mixing plant by pumping it through 8″ pipe. The sewer, U-shaped with flat top, 36″ to 48″ wide, was built with sides and top monolithic in 30′ to 50′ lengths; is so tight that infiltration ran only ¼″ deep at the lower end, with ground water standing above the top.[H41]

Septic odors from a trickling filter receiving septic tank effluent at Cherryville, N. C., causing suit by a resident 900 ft. away, were remedied by use of chloroben and enormous numbers of mosquitoes eliminated. The chemical, at the rate of 5 to 7 ppm, was diluted and applied from a small drum with a petcock lowered into a manhole at the head of each trunk sewer. The scum on the tank was so thick and dense that it could not be broken up by hand and light dynamite charges were used. Even then it would not settle; but after sprinkling chloroben on it and flooding it with fresh sewage it disintegrated and settled.[H42]

Sewage gas engine generator at Kokomo, Ind., saved $151 a month in power cost during the past eight months. A 3-cylinder 46 hp. gas engine is direct-connected to a 30 kw 3-phase 220 volt induction generator. Gas is formed in a multi-digestor, the first kept at 85° to 90° temperature producing 90% of the gas. All gas is measured by a diaphragm type sewage gas meter. The engine exhaust is run through a waste heat boiler which heats



Caisson for lowering ground water at Ley Creek plant

the primary tank and buildings. A louver-type water cooling tower is used when the digester coils do not dissipate all the heat. A thermostat keeps the jacket water at 140°. The only repairs made was grinding the valves about every 2,000 hrs.; the valves and rings are being built up with "stellite" facings which are expected to run about 6,000 hrs. between grindings. Cost of 8 mos. operation is $193.20 interest and sinking fund, $50 repairing valves, $56.80 for oil and $36 for labor, a total of $336. The power generated would have cost $1,544.65 at the commercial rate of 2.17 cts. per kwh. On this basis the annual saving would be $1,813.[H40]

Septic sewage gas has been deteriorating the concrete walls of a sewage pump at Coronado Beach, Calif., although made of dense 1:2:3 concrete and washed down once a week. Wire brushing and plastering with ½" of 1:2 mortar was not effective; neither was a 3-coat treatment of emulsified asphalt applied by pressure spray. Treatment made nearly a year ago with a protective coating called "Overcoat" so far shows no deterioration. This is a solution of inert plastics in a volatile solvent, combined with finely graded silica; first a penetrating primer is applied, then two 1/16 in. airspray applications of the coating, each covered with brush-applied clear solution to fill possible pinholes and dried for 24 hrs. The coating presents a hard, smooth surface with some inherent resiliency—can be dented by hammer without shattering.[E12]

Copper alloys for handling sewage have their limitations. Hydrogen sulphide and nitrogenous compounds are especially corrosive to copper alloys. In disposal plants high strength, resistance to wear and weldability are necessary, and silicon bronze alloys have found considerable use as weir plates, anchor rods, sluice gates, wire cloth screens, bolts, manhole steps, etc. Copper tubing has been used satisfactorily as heating coils in sludge digesters—though initially corroded by the sludge, it soon is covered with a protective scale of sludge which prevents further action.[G22]

Bibliography of Sewerage Literature

The articles in each magazine are numbered continuously throughout the year, beginning with our January issue.

c. Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract); *t*, technical article.

D *The Surveyor*
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35. Sewage Works Apparatus: Superintendents' Gadgets. Pp. 569-571.

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36. *p.* Recent Developments in Sludge Dewatering and Incineration. By A. S. Lowe, and C. D. Bottomley. Pp. 597-599.
37. Effect of Sewage on Deposits in the River Mersey. P. 603.

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38. *p.* Some Factors Affecting Design of Sewage Disposal Works. By J. Hurley. Pp. 657-659.

E *Engineering News-Record*
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12. Concrete in Closed Chamber Protected Against Gas. P. 659.

G *Water Works & Sewerage*
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21. Experiences with Asbestos Cement Pipe in Trunk Sewer Construction. By O. F. Gerlach. Pp. 532-534.
22. Selection and Use of Copper Alloys in Water Works and Sewerage Practice. By N. W. Mitchell. Pp. 555-559.

H *Municipal Sanitation*
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40. Gas Engine-Generator Reduces Kokomo Plant Operation Costs. By D. R. Miller. Pp. 252-253.
41. *c.* $2,500,000 Sewer and Plant End Ley Creek Pollution. By G. D. Holmes. Pp. 254-258.
42. Scum and Odor Control at Cherryville, N. C., Plant. By W. W. Dedmon. P. 258.
43. *p.* Complete Recovery of Distillery Wastes. By C. S. Boruff and D. Miller. Pp. 259-261.
44. Incineration of Municipal Refuse: Designing. By H. W. Taylor. Pp. 262-264.

J *American City*
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17. Small Activated Sludge Plant with Mechanical Aeration. (Waterloo, Ill.) Pp. 55-56.

P *Public Works*
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18. Chemical Sewage Treatment for Danville, Ill. By J. W. Nemoyer. Pp. 9-12.
19. *n.* Applying Sewage to Sand Beds. P. 18.
20. Solving a Storm Drainage Problem in DeKalb. By F. E. Peterson. Pp. 20-22.
21. Building Mosquitoes Out. By N. H. Rector. Pp. 34-35.

Preventing "Shut-downs" at Crucial Times . . .

CRYSTOLON BRICK

SCHOOL authorities cannot put up with boiler room "shut-downs" during the heating season. More and more their engineers are specifying Crystolon Brick for the boiler furnace walls since brick failures constitute the most frequent cause for "shut-down" time.

This installation in a Philadelphia high school building is a typical example. Installed in 1930 the Crystolon Brick are still in excellent condition as shown by the unretouched photograph, taken after the school closed for the summer holidays.

In buildings such as schools and hospitals which house children and invalids "shut-downs" are serious from the health and utility standpoint and Crystolon Brick are popular because of their uninterrupted service. Firemen like them because of the freedom from clinkers and slag.

NORTON COMPANY

Worcester, Mass.

New York Chicago Cleveland

NORTON REFRACTORIES

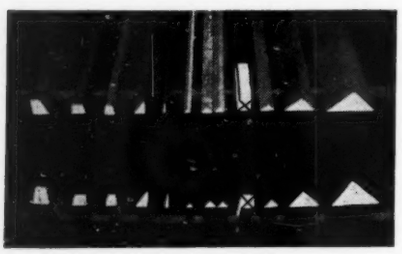
R571

Keeping Up With New Equipment

Better Edges on Your Concrete—at a Saving

The Tru-cut chamfer strips and mouldings are absolutely uniform, are without any waste at all, and will pass the most rigid engineering inspection. Every strip has sharp corners and extremely smooth saw faces. Every piece, no matter where cut, matches perfectly the end of every other piece of the same size.

These strips are made from carefully selected white pine or cypress, and are available in a variety of sizes. On concrete work made with these strips and moldings, finishing is reduced to a minimum and the quality of work is surprising. Suitable for any work, and especially for concrete highway construction. These strips are now being shipped to all points east of the Rocky Mountains

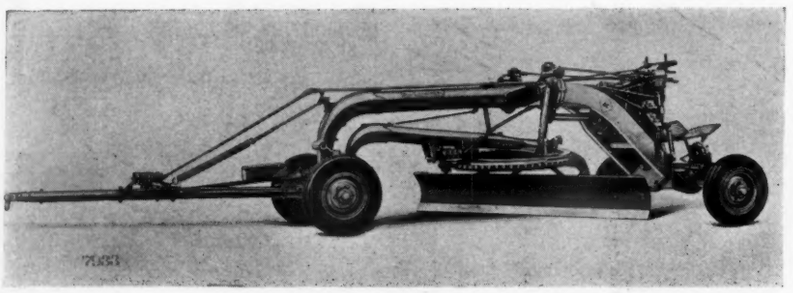


Some of the "Tru-Cut" family

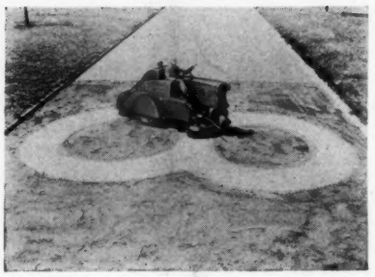
The makers say that the one best way to appreciate how much worry and time can be saved with these strips and how much better the finished job looks is to try them. Full information from Stuhlman Bros., Palmyra, Mo.

Those New Allis-Chalmers Blade Graders

The new 110 and 112 Allis-Chalmers blade graders were shown at the Road Show. Here is a detailed description of them. The outstanding feature is said to be the patented leaning frame, which is tubular, single section, all-welded construction. The leaning frame permits concentration of the weight of the machine on the blade when desired, and also provides an always level spring mounted platform for the operator, even when the rear axle is inclined on a 25° slope. Leaning wheels, automatic brakes, self-aligning bearings, pneumatic tires (when desired) and hydraulic controls are other features. For further information on this powerful grader write Tractor Division, Allis-Chalmers Mfg. Co., Milwaukee, Wisc.



The new Allis-Chalmers blade graders



The Austin-Western new patrol sweeper

Austin-Western Small Sweeper Is New

A small, simplified sweeper that cleans 5½ feet of pavement at a single pass, has been developed by The Austin-Western Road Machinery Co., of Aurora, Illinois. Though it thoroughly sweeps any part of the street, according to the manufacturers it was engineered primarily to clean the gutter area where dirt usually collects. It is equipped with two revolving brooms and can be used the year around to pick up litter, cinders, leaves, broken glass and even bricks.

The Patrol Sweeper, as it is called, is completely equipped and is very compact. It is powered with a four-cylinder, 29 H. P. motor for operation on steep grades as well as on level pavements. To lay the dust and penetrate crusted dirt it uses a pump driven spray. To scour the pavement near the curb where dirt formations are thickest, it uses a "bumpproof," fast revolving steel broom, that flares out to 32 inches. To pick up litter and leave a clean surface it is equipped with a tough, fibre broom measuring 36 inches in diameter. The rotation of this broom throws the dirt and rubbish into a one cubic-yard capacity trash box.

When the operator wishes to dump the load, he fingers a small (hydraulic power) control lever which automatically raises and tilts the trash box and deposits a compact load behind the sweeper. With this arrangement the sweeper can continue its work without backing up or tracking over the load.

Kwik-Mix 3½-S Concrete Mixer

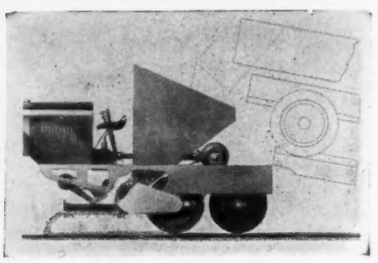
A new 3½-S Mascot has been designed and built by the Kwik Mix Concrete Mixer Co. of Port Washington, Wis. It is of compact construction, with an air-cooled gasoline engine mounted within the natural overall dimensions of the mixer proper. No additional structure has been added for this purpose, to increase unnecessarily the overall dimensions of the mixer. The end discharge feature permits wheelbarrow spotting, without turning or backing. Weighs less than 1000 pounds, it is easily handled, spotted or trailed. Also many other additional features. Ask for Booket KM 134.

Kwik-Mix 3½-S mixer

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 55-57

"Chip-Top" Spreaderoller

The Universal Crusher Company has introduced a material spreader of entirely new design for seal coating and spreading all types of stabilized road materials. Known as the Universal Spreaderoller this new machine segregates the aggregates into coarse material, medium sized material and fines,



Combined spreader and roller.

depositing them in that order on a freshly sprayed bituminous surface and rolling them smooth all in one operation and with one machine.

The Spreaderoller consists of a chassis mounted on three rollers, the third of which is at the back of the machine directly behind the inside edges of the two forward rollers. The two forward rollers are driven and the machine is steered by braking either right or left driven roller. Mounted on the chassis is an industrial power unit and a hopper with mechanical distributor which feeds the aggregates to a shaker screen.

A portable ramp is towed by the Spreaderoller which permits trucks to back up to and back-dump into the hopper. The machine need be stopped only a matter of seconds for charging the hopper. This method keeps trucks off the fresh bituminous application.

It is claimed that this equipment provides a better and more closely bound road because coarser materials are spread first and finer materials on top, and the whole immediately rolled before the fines have a chance to filter through, and before the bituminous treatment has a chance to set. Roads seal coated with the Spreaderoller are highly skid-proof in all weather; and, being light in color, are visible at night and in the fog.

Roads so built are immediately ready for use; and, since the Spreaderoller surfaces any width up to 10′, even narrow roads need not be closed as traffic can by-pass on the half of the road not being surfaced. Fewer trucks are needed.

The manufacturer states that the Spreaderoller meets all the requirements of a 10-ton roller and can be used for that purpose, as well as for spreading base coarse materials and all types of topping materials for stabilized roads. It has a low fuel consumption, is easily controlled from the operator's platform, and can be run in either direction. It can be used for the original surface or for resurfacing and for city street paving, walks, parking lots, bridge floors, etc. Approximately ¾ to 1 mile of highway 10′ wide can be surfaced per hour, spreading from 15 to 25 lbs. or more of material per square yard.

Specifications and information from Universal Crusher Co., Cedar Rapids, Ia.

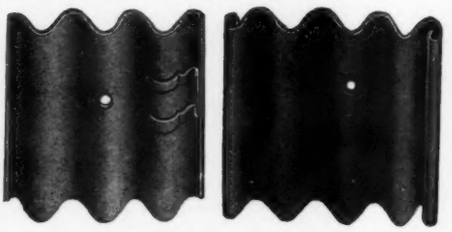
Utility and Artistic Design in Tank Car Heaters

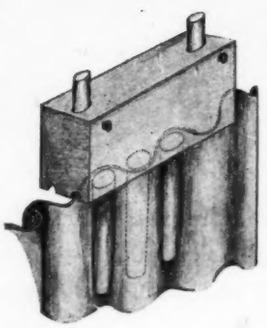
The accompanying cut, showing the 1938 Cleaver tank car heater, illustrates what can be done in artistic effect with even such a prosaic subject as a steam boiler. To the modern styling of this heater has been added new and important savings in operation, according to the manufacturers, the Cleaver-Brooks Co., Milwaukee, Wisc. Under the steel covering is an oil burning steam generating plant of the horizontal fire tube type, especially designed for burning fuel oils. The burner atomizes the fuel and a gasoline driven blower furnishes the correct amount of air at the correct pressure to provide complete combustion. The gases are then forced four times downward through a long gas travel. Insulation is furnished around the boiler shell, to prevent heat losses and over this is the streamlined sheet steel lagging. The oil burner and other operating machinery is also covered by sheet steel housing. The unit is self-contained and is mounted on a high speed, roller bearing, rubber tired trailer for quickly moving from one location to another. When connected to the tank car, the unit becomes practically automatic, requiring but little attention.

The new Cleaver continuous drainage system is the outstanding feature of these new models. It keeps tank car coils bone dry and the manufacturer states that ordinarily less than a gallon of make-up water per hour is required. This new return condensate system brings water back into the boiler at practically steam temperatures, thereby saving fuel and at the same time, heating the material in the car very more rapidly.

Sheet Piling That Can Be Used Many Times

Here is a light metal sheet piling that can be handled easily, driven by hand or power, is watertight, and can be reused over and over again. On trench work, it





Left, above, plain section of corrugated piling; right, above, interlock section. Left, driving cap.

has been pulled and reused 100 times, the manufacturers say. The interlock (furnished if desired), makes it watertight. Sheets can be nested for convenience in moving or storage. A supply of these should be very handy for the county (on cofferdams, bridges, culverts retaining walls and bulkheads), and the city or village (sewers, water mains, treatment plants, dams, etc.). Full information on request from Corrugated Steel Sheet Piling Corp., 228 No. LaSalle St., Chicago, Ill.

The streamlined Cleaver tank car heater.

Good for the Last Drop—the IMO Meter

The IMO meter, displayed at the AWWA Convention at New Orleans for the first time by the Pittsburgh Equitable Meter Co., Pittsburgh, Pa., is described as the first practical innovation in domestic water meter design and construction in over 50 years. The name IMO is derived from a portion of the name of the Swedish firm which holds the basic patent. The Pittsburgh Equitable Meter Co. has been assigned the sole license to manufacture and sell these meters in the U. S., Mexico and Canada.

The manufacturer claims the IMO is the most accurate water meter ever commercially built. Published accuracy curves show 90% registration at 1/12 of a gallon per minute, while at the rate of ¼ gallon per minute the IMO is said to measure 100%. From this point on out to its maximum rate of 20 gallons per minute shows a flat curve. This capacity is said to be based on its unique measuring chamber and operating units. These consist of three screws or rotors which mesh with each other and fit the bore of a surrounding casing or measuring chamber. Water enters the measuring chamber from the bottom and, as it is forced upwards by line pressure, causes the rotors to turn, passing through in a perfecly continuous flow. The threads on the rotors act as a continuous piston which always moves in a forward direction. The register on the Pittsburgh IMO is driven by the action of the center rotor through an oil enclosed gear train.

Further data from Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

The Measuring Chamber — **The Pittsburgh IMO Water Meter** — **The Rotors**

Yeomans Acquires Simplex Sewage Treatment Equipment

Yeomans Brothers Company of Chicago, Ill., have acquired from the Simplex Ejector & Aerator Corp., also of Chicago, all patterns, drawings, engineering data and the exclusive right to the use of the established trade name covering Simplex Aerators, Distributors, Dosing Siphons, Combination Aerators and Settling Tanks and Sludge Division Boxes and Clarifiers. All of this equipment will now be manufactured in the Yeomans plant and will be distributed thru their organization of some fifty district sales representatives in the United States and possessions and various foreign countries. William Buckley, president of the Simplex Ejector & Aerator Corp., will, for some time act in a consulting capacity for Yeomans Bros. Company.

Cedar Rapids Stabilizer Plant

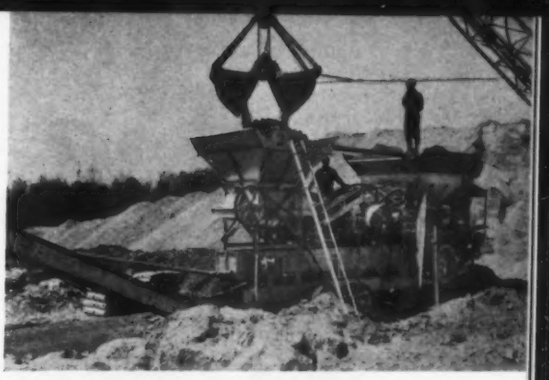
The new Cedar Rapids stabilizer plant for mixing clay-soils, aggregates, calcium chloride, salt, etc., has been announced. The plant consists of one main truck unit, pneumatic tired, on which is mounted the various processing units. Because the plant setup is generally made at stock piles, the stabilizer plant is designed for clam shell feeding with large receiving hoppers above both the aggregate and clay-soil feeders. The finished mix is discharged onto a delivery conveyor which can be designed for direct truck loading or delivery to a storage loading hopper or bin.

The aggregate is fed through the aggregate feeder in predetermined quantities direct to the pugmill. The clay-soil is fed by mechanical screws to the short belt conveyor leading to the disintegrating crusher where the clay-soil is processed to specifications and then discharged to the pugmill. A separate calcium chloride or salt feeder, used to introduce these items, is designed so the feed is in constant proportion to the balance of the materials according to specifications. The mixing is done in a long single shaft pugmill which can be raised or lowered from the horizontal operating plane as required to secure the best mix.

The entire plant is operated from one power unit which can be either gas or Diesel, at the option of the purchaser. Descriptive details and information from the Iowa Manufacturing Company, Cedar Rapids, Iowa.

Barricades, Supports and Sign Easels

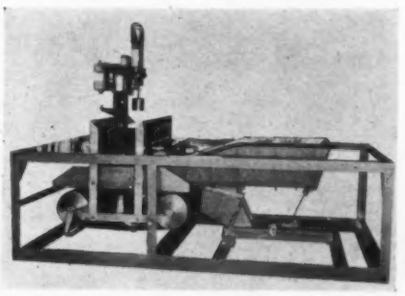
Now is the time when a good deal of work is being done along streets and highways—and to safeguard the men at work proper barricades, supports and signs are needed. Dura-Flex barricade supports are of metal, and are light, strong and firm. Wind won't blow them over. Legs are of standard half-inch pipe, easily replaced. The sign easels take either the square or diagonal type of warning sign, also school and other signs. Excellent folder available from J. C. Kintz, Quincy, Ill.



New Cedar Rapids stabilizer plant

Continuous Weigh Feeder

Syntron Co., 660 Lexington Ave., Homer City, Pa., has an automatic continuous weigh feeder that will handle most any kind of bulk materials, from dry chemicals, through sand and stone to coal. A constant load, by weight, is maintained on a constant speed conveyor, with a vibratory feeder. It is claimed to have almost 100% accuracy and is available in capacity from 25 pounds to 25 tons per hour. That is a big enough range for most any job.



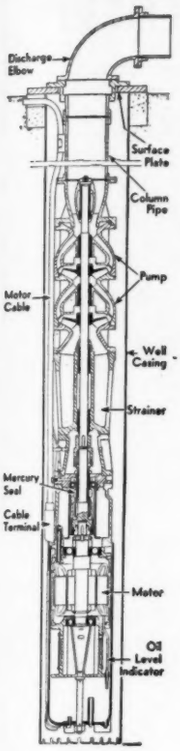
Syntron feeder

Chicago Buys Some Fire Hydrants

Koppers Co., Western Gas Division, Fort Wayne, Ind., was recently awarded a contract for 2100 fire hydrants for the city of Chicago, these to be built to the city's own standard specifications.

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 55-57

KEEPING UP WITH NEW EQUIPMENT



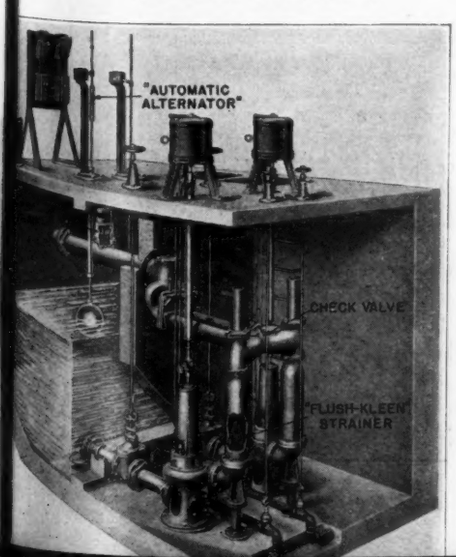
Left, the Byron Jackson deep well pump is shown in section.

Above illustration shows smoothness of Flexcell expansion joints. Insert at right shows uniformity.

Byron Jackson Submersible Deepwell Turbine Pump

This pump, it is stated, will operate in crooked or straight, deep or shallow wells, sumps, cisterns or pools. It requires no above-ground pump house to protect the motor. It is noiseless in operation. The entire unit is attached to and supported by the discharge pipe and the only other connection with the surface of the ground is the power cable and a small copper oil tube. The motor remains submerged in the liquid pumped at all times, the electrical parts and bearings being enclosed in an oil-filled case with mercury seals. It cannot be drowned out. Full information from Byron Jackson Co., Dept. 198, Los Angeles, Calif.

Flush-Kleen sewage pump



Flexcell Expansion Joints

The Flexcell Co., 919 North Michigan Ave., Chicago, Ill., manufacture Flexcell expansion joints of cane fiber treated with an asphalt compound. It is stated that Flexcell joints are proofed against termites and against moisture, and that they will not extrude under compression. These joints, which are used for all kinds of concrete work—highways, sidewalks, curbs, bridges, retaining walls, etc.—are fully described in an excellent folder which will be sent on request.

Air and Gas Aftercoolers

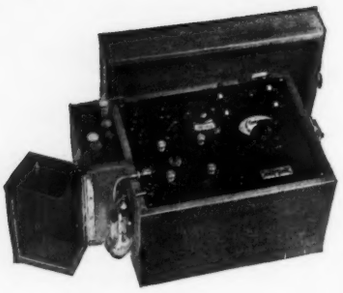
Sullivan Machinery Co., Michigan City, Ind., has just issued a new bulletin on their compressed air and gas aftercoolers. These are made in six sizes, from 125 to 755 cubic feet per minute, and are equipped with built-in moisture and oil separators. Ask for Bulletin A21.

Something New in Sewage Pumps

"Flush - Kleen," an unusual sewage pump with a cleverly placed, self-cleaning strainer, never clogs, it is claimed, and requires no attention, except periodical lubrication. They are installed in duplex sets with an automatic alternator to transfer the operation from one pump to the other. Only one pump operates at at a time.

While one pump is operating, sewage flows into the basin through the idle pump. Coarse solids are stopped by the strainer in the idle pump and is held in the strainer chamber built in the discharge line of the pump. Only water passes into the basin.

When the idle pump starts, the accumulation of coarse solids in the strainer chamber of the pump is flushed out with the water, just like backwashing a filter, and is discharged to the sewer. A check valve in the inlet is forced shut when the pump starts. This prevents the pump from discharging back through the inlet line. Each pump is float-controlled, and the alternator transfers the operation from one pump to the other. Chicago Pump Co., 2338 Wolfram St., Chicago, Ill.



L & N pH Indicator

Universal pH Indicator

This instrument reads directly in pH with glass, quinhydrone, hydrogen or any other electrode following the Nernst equation. When used with the glass electrode system furnished or with the quinhydrone electrode, simply setting the dial of the temperature compensator adapts the entire pH scale to measurements at that temperature. Equipped with a voltage scale as well as a pH scale, it is also used in oxidation-reduction potential measurements, and in current and resistance determinations. It can be used with external circuits of much higher resistance than the 100 to 300 megohms of the glass electrode which is supplied with it.

This newly-designed glass electrode is small and requires only a 5 ml sample for measurement. Everything necessary for glass electrode measurements is included with the instrument.

Other features include: quartz insulation, where necessary, to avoid leakage errors; a separate battery compartment to prevent corrosion; unimpaired accuracy in atmospheres of up to 95% relative humidity; the ability to make sodium corrections, where necessary, directly in pH units. Further information from Leeds & Northrup Company, 4934 Stenton Avenue, Philadelphia, Pennsylvania.

SENT ON REQUEST

Water Supply Systems for homes, resorts, camps, farms, etc., are described in Bull. 260-B13C, by Roots-Connersville Blower Corp., Connersville, Ind. Especially good dope on estimating quantity. How much per cow per day? Per chicken? This tells.

How to Join Pipe Without Threading is a 16-page booklet describing the many uses of the Style 65, no-thread fittings made by S. R. Dresser Mfg. Co., Bradford, Pa.

Actual job stories in "Stay in Business," a 16-page folder on general construction, issued by R. G. LeTourneau, Inc., Peoria, Ill.

A booklet on pipe jointing with Haymanite, 8 pp., illustrated, is available from Michael Hayman & Co., Inc., Buffalo, N. Y. Gives instructions and directions for use with bell and spigot cast iron water pipe.

Hoists and gates for water control are described in an excellent catalog just issued by S. Morgan Smith Co., York, Pa. 32 pages; technical data and excellent illustrations of equipment in use under various conditions.

Tank car heaters are described in a new catalog by Cleaver-Brooks Co., Milwaukee, Wisc. These include Streamlined steam heaters; automatic heaters for asphalts, tars and other bituminous materials; also the new tank car unloading valve, and the "Oilbilt" steam generating plants. Of especial interest and value to those who build and maintain bituminous roads.

Valves, fittings, pipes and tools—602 pages of them—are illustrated and described in Catalog 89. Walworth Co., 60 East 42nd St., New York.

A roller chain data book has been issued by Link-Belt Co., Chicago, Ill.; 174 pages of practical information, application pictures and engineering data. Ask for book No. 1757.

County and Government dirt moving projects have been covered in a folder just issued by R. G. LeTourneau, Inc., Peoria, Ill. Illustrates a variety of cost-cutting jobs, including highway work, airport construction, maintenance, etc.

The Austin-Western 3-wheeled model elevating grader is described in Bulletin 1728. Austin-Western Road Machinery Co., Aurora, Ill.

INDEX TO ADVERTISEMENTS

Readers' Service Department

These booklets are FREE to readers of PUBLIC WORKS.

CONTINUED FROM PAGE 56

Feeders, Chlorine and Chemical

387. For chlorinating small water supplies, swimming pools and other installations. Flow of water controls dosage of chlorine (or other chemicals) providing required dosages, which are immediately adjustable. Driving is started and stopped automatically. Send for newest literature. %Proportioneers%, 9 Codding St., Providence, R. I.

Filter Plant Controllers

388. "The Modern Filter Plant" and the uses of Simplex Controllers for operation are described in a handy, 16-page booklet. Charts, data, curves and tables. Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Flow Meters

389. The primary devices for flow measurement—the orifice, the pilot tube, the venturi meter and others—and the application to them of the Simplex meter are described in a useful 24-page booklet (42A). Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

Gate Valves and Hydrants

390. An 84-page catalog gives full design data, information about and illustrations of the complete line of Darling Gate Valves and Hydrants. Write for one to Darling Valve and Mfg. Co., Williamsport, Pa.

391. Two new bulletins on M-H fire hydrants and fully bronze mounted gate valves are now ready. Contain full specifications and instructions for ordering, installing, repairing, lengthening and using. Write M. & H. Valve & Fitting Co., Anniston, Ala.

392. 28 page catalog contains illustrations and complete specifications of M-H standard and extra heavy iron body gate valves, horizontal swing check valves, flanged fittings and flanges, etc. Sent promptly on request by M. & H. Valve & Fittings Co., Anniston, Ala.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter, crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

Pipe, Cast Iron

406. Data on cast iron pipe for water works systems, in sizes from 1¼ to 84 inches, including information on useful life, flow data, dimensions, etc., Thos. F. Wolfe, Cast Iron Pipe Research Ass'n, 1013 Peoples Gas Bldg., Chicago, Ill.

Pipe, 2-inch Cast Iron

407. The new McWane 2" cast iron pipe in 18-foot lengths has innumerable uses in water and sewage work. Send for the new McWane bulletin describing this pipe, the various joints used, and other details about it. McWane Cast Iron Pipe Co., Birmingham, Ala.

Pipe, Large Cast Iron

408. Handy cast iron pipe and fittings catalog contains A.W.W.A. and A.G.I. standard specifications for a wide variety of cast iron pipe specialties, both bell and spigot and flanged; also dimensions Lynchburg Foundry Co., Lynchburg, Va.

409. Information on concrete pipe for sanitary or storm sewers which can be made anywhere by manufacturer using local labor and materials. Write Concrete Pipe Machinery Co., Sioux City, Iowa.

Pipe Forms

411. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Pipe Joints

412. New folder describes in detail a new type of pipe joint—the Dresser Compression Coupling Style 65, which is compact and self contained, makes a permanently tight joint under all conditions and is installed on plain end pipe in a few seconds with only one tool, a wrench. Get your copy today. S. R. Dresser Mfg. Co., Bradford, Pa.

Taste and Odor Control

417. How, when, and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Div., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

418. Information on activated carbon for taste and odor control including data on operating experiences. Write L. A. Salamon & Bro., 216 Pearl St., New York, N. Y.

Pumps and Well Water Systems

420. Installation views and sectional scenes on Layne Vertical Centrifugal and Vertical Turbine Pumps, fully illustrated and including useful engineering data section. Layne Shutter Screens for Gravel Wall Wells. Write for these three descriptive booklets. Layne & Bowler, Inc., Dept. W, General Office Memphis, Tenn.

Pumping Engines

424. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Run-off and Stream-Flow

425. Excellent booklet describes and illustrates the latest types of instruments for measuring run-off, both from small areas for storm sewer design, and from large areas for determining water shed yield. Sent promptly by Julien P. Friez & Sons, Baltimore, Md.

Screens, Sewage

428. Be assured of uninterrupted, constant automatic removal of screenings. Folder 1587 tells how. Gives some of the outstanding advantages of "Straight-line Bar Screens" (Vertical and Inclined types). Link-Belt Co., 307 N. Michigan Avenue, Chicago, Ill.

Setting and Testing Equipment for Water Meters

430. All about setting and testing equipment for Water Meters—a beautifully printed and illustrated 40 page booklet giving full details concerning Ford setting and testing apparatus for all climates. Ford Meter Box Co., Wabash, Ind.

Rainfall Measurement

432. The measurement of precipitation, exposure of gauges, description of apparatus for measuring rainfall, both rates and amounts. Bulletin RG and Instruction Booklet. Julien P. Friez & Sons, Baltimore, Md.

Screens

435. Water Screen Book No. 1252, describes traveling water intake screens and gives complete technical information about them. Link-Belt Co., 307 No. Michigan Ave., Chicago, Ill.

Sewage Filters, Magnetite

436. Well illustrated booklet describes the magnetite filter, and tells how it is used in the treatment of Sewage. Copy on request from Filtration Equipment Corp., 10 East 40th St., New York, N. Y.

Small Septic Tanks

438. Septic Disposal Systems, Waterless Toilets, Multiple Toilets for Camps and Resorts, and other products for providing safer sewage disposal for unsewered areas are described and illustrated in data sheets issued by San-Equip, Inc., 700 Brighton Ave., Syracuse, N. Y.

Sludge Incineration

440. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection, 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202P East 44th St., N. Y.

Swimming Pool Equipment

444. A new booklet "Essential Factors in the Design and Layout of Swimming Pool Systems," with data on filtration equipment, fittings, solution feeders, accessories, etc., is available from Everson Manufacturing Co., 213 West Huron St., Chicago, Ill.

445. Data and complete information on swimming pool filters and recirculation plants; also on water filters and filtration equipment. For data, prices, plans, etc., write Roberts Filter Mfg. Co., 640 Columbia Ave., Darby, Pa.

446. 40-page Manual on swimming pools. Includes swimming pool layouts, specifications, etc., and details concerning Permutit Swimming Pool Equipment. Write The Permutit Co., Dept. G-4, 330 West 42 St., New York, N. Y.

Treatment

450. Standard Sewage Siphons for small disposal plants and PFT Rotary Distributors are new catalogs recently issued by Pacific Flush Tank Co., 4241 Ravenswood Ave., Chicago, Ill. The latter catalog contains typical plans and many illustrations of actual installations.

453. New booklet on Link-Belt Circuline Collectors for Settling Tanks contains excellent pictures and drawings of installations, sanitary engineering data and design details. Link-Belt Company, 307 North Michigan Ave., Chicago, Ill.

454. Full information regarding their newest equipment for sewage treatment and water purification will be sent on request by The Dorr Co., 570 Lexington Ave., New York, N. Y.

Water & Sewage Treatment Chemicals

500. Aluminum sulphate and ferric chloride for sewage coagulation, and these chemicals and ammonia, copper sulphate and others for water treatment. Information on uses and methods sent on request to General Chemical Co., 40 Rector St., New York, N. Y.

501. "Ferrisul for water and sewage treatment." What it is; what it will do for you and how to use it—a handy booklet issued by Merrimac Chemical Co., Everett Station, Boston, Mass.

Valve Box Tops

475. "Cut the Cost, but Not the Pavement," is the theme of a new bulletin on Rite-Hite Valve Box Tops. Gives directions for forming new tops on valve boxes, quickly and inexpensively without digging up the old box. Just issued by Trohn's Supplies, Inc., 205 Hoyt Ave., Mamaroneck, N. Y.

Water Works Operating Practices

490. "What Is New In Coagulation" is an excellent, new review with bibliography and outlines of latest work done in the field. Written by Burton W. Graham and sent free on request to Activated Alum Corp., Curtis Bay, Baltimore, Md.

For the Engineer's Library

Brief reviews of the latest books, booklets and catalogs for the public works engineer.

Soil Stabilization with Tarvia:

A booklet covering step-by-step procedure in stabilizing roads with Tarvia. Preliminary investigations, depth, kind of aggregate, moisture content; construction, loosening, admixtures, pulverizing, applying water, applying Tarvia, mixing, prime coat, compacting, tack coat and seal coat; also machine mixing. Sent on request to G. E. Martin, Tarvia Dept., Barrett Co., 40 Rector St., N. Y.

Wood Pipe and Wood Tanks:

The "Wood Pipe Handbook" contains 265 pages and over 150 illustrations. The subject matter ranges from hydraulics to a description of the manufacture and application of wood pipe. Especially valuable is a section in which problems encountered by engineers are solved both scientifically and through the use of flow tables prepared especially for this handbook. In convenient pocket size. "Wood Tank Catalog No. 37" describes tank installations of a wide variety. It shows how tanks and their foundations are designed and erected. Typical illustrations make perfectly clear many features of tank construction not usually published. Copies from National Tank & Pipe Co., Portland, Oregon.

Sewage Plant Operation:

This is a 24-page booklet that gives detailed and precise instructions on operation of a Chicago combination aerator-clarifier sewage treatment plant. It discusses sewage, operation of the primary tank, flow through the equipment, operation of an activated sludge plant, starting up a new plant, shutting down an aerator, digestor operation, records, suggested daily operating routine, operating hints and aids, methods of analyses and a sewage plant laboratory list. This is the best commercial publication we have seen on operation. We believe it will be sent on request to L. P. Blattner, Chicago Pump Co., 2338 Wolfram St., Chicago, Ill.

Inten-Cement:

A 16-page booklet full of practical information on concrete construction with this cement admixture. Covers water-cement ratio; aggregate; intencement; quick-set; hot-caking; antifreeze; waterproofing; crack treatment; plaster coats; use in sea water; placing concrete under water; and patching concrete pavements. Illustrations and charts help. For copy write Harrop Chemical Co., 135 Hoboken Ave., Jersey City, N. J.

Industrial Paints:

Industrial paints of many colors are illustrated (in their proper colors) and the paints and their uses described. Alkali and acid-resisting paints; aluminum paint, heat, acid and alkali resisting; concrete and masonry paint; dampproofing; heat resisting paint; wet-wall basement paint, and plenty of others. How to use and how much. Skybrite Co., Cleveland, Ohio.

Shriver Filters:

These are filters in which cloths, usually coated with a filtering material, are used in place of sand or similar media. They should not be confused with presses, for they are a true pressure filter used primarily in industrial work; they are especially valuable because of their light weight for temporary water filter installations. This complete catalog and data book describes how these filters work; gives detail information on operation and shows suggested layouts. Also describes the Shriver diaphragm pumps. T. Shriver & Co., Harrison, N. J.

Stabilizing with Calcium Chloride:

Brief No. 134, just issued by Calcium Chloride Ass'n, Detroit, Mich., is intended to provide practical and technical information on how and why calcium chloride acts in aiding density and compaction of soil mixtures. Largely based on data developed by U. S. Bureau of Public Roads.

Sodium Aluminate:

The uses of this chemical in water purification are treated in an excellent little booklet issued by Merrimac Chemical Co., Everett Station, Boston, Mass. Properties are discussed and reactions given; its uses in boiler feed water treatments are given briefly; also its use as a coagulant for municipal and industrial waters. 14 pages.

Water Works Protection:

The Barrett Water Works Protection Book is beautifully arranged and illustrated—and equally valuable. It covers the protection of steel and cast iron water mains and also dams, penstocks, tanks and other appurtenances. Available on request; Barrett Co., 40 Rector St., N. Y.

Power Impulse Turbines:

Describes the Smith impulse turbine wheels, shows pictures of installations, gives power curves for installations, illustrates typical arrangements and installations, and presents a valuable data section on power, flows over weirs and flow in pipes. 32 pages. Sent on request. S. Morgan Smith Co., York, Pa.